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AN AMERICAN VIEW OF RAW MATERIALS PROBLEMS

The Report of the President's Materials Policy Commission[1]

by E. S. MASON

THE Report of the President's Materials Policy Commission published in June of this year is, to say the least, a comprehensive document. It purports to cover all materials except foodstuffs and to survey the materials problems not only of the United States but of the western world. Since the author of this paper was a member of the Commission he does not pretend to speak with critical objectivity of the Report; nor does he pretend to represent the views of his fellow Commissioners. The following remarks are rather the reflections of one individual on some of the issues that impend in the raw materials area.

The appointment of the Commission a few months after the outbreak of the Korean war indicated a serious and growing concern in the United States for the continued adequacy of raw materials supplies. Rates of consumption during World War II were, of course, huge and the extraordinarily high production of durable goods during the post-war period created abnormally large requirements, particularly for mineral raw materials. Added to this were the increased and speculatively accelerated material demands of the Korean war and rearmament. During the period from 1940 to 1952 shortages of important raw materials in the United States have been sufficiently serious to justify direct government controls in nine of the twelve years. And, during the same period of time, there may have occurred a reversal of long-term downward trend in the real cost of producing raw materials.

Although the establishment of the Commission coincided with, and was probably induced by, the reappearance of serious shortages of materials, its concern has not been with the short-run problem but rather with what may be expected over a longer period of time, a

[1] Volume I *Resources for Freedom*, presents the general analysis and the Commission's recommendations.
Volume II *The Outlook for Key Commodities*, in addition to discussion particular materials, includes the projections of material requirements, data on mineral reserves and the production and consumption measures used by the Commission.
Volume III *The Outlook for Energy Sources*, discusses Coal, Electric Power, Natural Gas and Oil.
Volume IV *The Promise of Technology* contains the major technological papers prepared for the Commission by various Research Departments and Laboratories.
Volume V *Basic Reports to the Commission*, includes staff papers.

period, somewhat arbitrarily, defined to embrace the next quarter-century. Short-run variations in supplies and requirements, the well known volatility of raw materials prices, which may well be accentuated if the post-war pattern of alternate reduction and increase in armament expenditure is continued, are considered only in relation to the long-run availability of supplies. The major problems considered by the Commission arise, on the one hand, from the effects of exponential rates of economic growth on requirements for raw materials and, on the other, from the possibility that, at any time, an outbreak of war may simultaneously and radically change materials requirements and remove customary sources of supply. These are the real materials problems that, over time, confront the Free World.[1]

THE TERMS OF TRADE

The projections of materials requirements used by the Commission assume for the United States a 28 per cent increase in population during the next quarter century and a 2½ per cent per annum increase in the *per capita* productivity of the labour force. These assumptions yield a doubling of gross national product by the mid-1970s. If this growth rate is realized it is projected that overall materials requirements will be some 60 per cent higher in 1975 than in 1950, with minerals requirements rising some 90 per cent and the requirements for agricultural products by 40 to 50 per cent.

The conclusion that a doubling of gross national product could be accomplished with a consumption of raw materials only 60 per cent higher than in 1950 may seem surprising. During the post-war years, however, including 1950, production, in the United States, of durable goods, which are heavily material using, has employed a higher percentage of the labour force than can be expected to continue. Then, too, there is a fairly clearly marked trend towards a higher degree of fabrication of materials which yields, over time, a lower material input per unit of national output.[2] Finally, although it is not visible in the statistics of employment during the last two decades, there probably exists an underlying trend towards tertiary employments, which are not heavily materials consuming.[3]

Growth rates in the United States may well exceed those in most

[1] Nothing is said in this paper concerning raw materials in relation to military security. This subject is treated in the Report, Vol. I, Section VI *Foundations for Security*, and is referred to in various sections of the other volumes.

[2] e.g. in dollars of constant value, each dollar of raw materials cost in 1900 yielded $4.20 in finished products and services; in 1950 the figure was $7.80.

[3] The projections of materials requirements are discussed in detail in a paper by Arnold C. Harberger, published in Vol. II.

other industrialized areas of the free world. On the other hand, given a rapid industrialization of underdeveloped countries, their materials requirements could increase at a much higher rate than is projected for the United States. Even very high rates, however, would not greatly affect the total figures since the percentage of raw materials consumption accounted for by those countries is very small. It is, perhaps, not unreasonable to assume, over the next quarter century, for the free world as a whole, something less than a doubling of gross income accompanied by a 60-70 per cent increase in consumption of raw materials including foodstuffs.

One of the central questions, having particular urgency for industrial countries heavily dependent on imports of raw materials and foodstuffs, is what, under these circumstances, is likely to happen to the terms of trade of manufactured for primary products.[4] If the terms of trade are not to worsen for producers of manufactures 50-60 per cent expansion of primary production must be accomplished at real costs that decline approximately as rapidly as may be expected for manufactured products. It may be anticipated with some confidence that the real cost of fabrication *will* decline as improved technology reduces the factor imputs required to convert a bale of cotton into yards of fabric, tons of iron ore of given grade into tons of ingot steel, and cubic yards of clay into brick. Can and will improved technology and organization accomplish a similar reduction in the real costs of wringing primary products from a limited physical environment?

It is fairly clear that, during the period 1875-1940 the real costs of primary production have not only declined as rapidly as the real costs of fabrication but more rapidly and that the economic growth of Western Europe and the United States has been heavily dependent on the rate of improvement of primary production. During the twenty-five years preceding 1900 the terms of trade moved strongly in favour of manufactured products. The fact that this movement was temporarily checked during the period 1900-14 may have had

[4] If resources are fairly free to move among countries a worsening of the terms of trade for manufactures will mean real costs for primary production rising in relation to real costs of manufactures the world over. In any particular country — in varying degrees depending on how effectively economies are sheltered by transport costs and on the shape of domestic cost functions — resources tend to be reallocated in line with the changing terms of trade. Thus in both industrial and raw materials producing countries a movement of the terms of trade against manufactures leads to higher imputs into primary production. Barriers to trade and to the movement of resources and, in particular, domestic policies favourable to industry or vice versa, can cut this connection. Thus a primary producing country can find its own terms of trade of primary versus manufactured output turning against primary production even though, in international trade, the movement is in the reverse direction. Needless to say it is the trend of real costs of both primary and secondary production (rather than the terms of trade) that is relevant to growth of national income.

something to do with the apparent slowing down of *per capita* productivity both in Britain and the United States during these years. The very great improvement in their terms of trade during the inter-war period certainly sheltered Britain from the full economic consequences of the great depression.

The Report of the President's Commission does not attempt to arrive at conclusions concerning the probable movement of the terms of trade. On the basis of date assembled by the Commission, however, certain tentative propositions seem warranted. Granted a relative freedom for resources to move to lowest cost sources of supply and for materials to move to highest priced markets there is little evidence to support the contention that terms of trade must necessarily turn sharply against manufactures. This appears to be true even if a large increase in population is assumed. If, in fact, the terms of trade do worsen substantially for manufactures it will be mainly because currencies are not convertible for purchase in lowest priced markets, because certain countries embark on irrational programmes of industrialization, because increased obstacles are placed in the way of the flow of foreign capital particularly into minerals development, and because, in general, policies of self-sufficiency reign supreme.

A substantial worsening of the terms of trade for manufactures brought about by diversion of resources towards industrialization in the primary producing countries would obviously affect adversely the interests of the industrial countries of Western Europe, Britain and Japan. The concomitant improvement in the terms of trade for primary production, on the other hand, would not necessarily promote the interests of the raw material producing countries if it is purchased at the expense of a drift from low-cost imported manufacturers to high-cost domestic production. For reasons that will be developed presently the extent to which a development of the sort here indicated could affect growth rates in the United States is substantially less than in most other countries. On a broader view, however, the interests of the United States could not help but be seriously threatened by a series of measures that may not only check the rate of economic growth in the free world as a whole but impose on certain countries problems of adjustment to which their economic and political structures are not well adapted.

This problem of bringing about a balance between industrial development and raw material expansion that will facilitate economic growth not only in industrial but in primary materials producing countries is obviously one of the critical problems of international organization. The President's Commission quite naturally looks at

the question mainly from the point of view of the United States which is likely to become an increasingly important net importer of mineral products though it may continue to be a net exporter of agricultural materials and foodstuffs. Currently the import of minerals is overwhelmingly from American owned production abroad and consequently a central concern of the Commission is how obstacles to the expansion of minerals output under American ownership and control may be overcome. When agricultural production is included and the interest and ideologies of other countries fully taken into account, it seems possible that a broader view of feasible international arrangements and a more venturesome consideration of alternative economic instrument abilities than the Commission was willing to attempt may have to be undertaken. However that may be it is necessary at this point to consider further the proposition that a substantial change in the terms of trade adverse to manufactured products is more likely to be the result of national policies of self-sufficiency than of the inevitable pressure of increasing requirements on limited natural resources. The relevant evidence may most conveniently be discussed under the headings agricultural resources, minerals, and energy resources though the latter two categories obviously overlap.

AGRICULTURAL RESOURCES

The Commission's Report deals at length only with the situation in the United States though a careful consideration of the American data makes it possible to venture an opinion on agricultural prospects elsewhere.

The leading conclusion that emerges from a study of the American material is that U.S. requirements for domestically produced food stuffs and agricultural raw materials can easily be satisfied over the next quarter century with a continually declining employment in agriculture. Currently — and for the last ten years — the United States has been a net exporter of agricultural materials on a small scale and could produce a large surplus for export with little increase in the agricultural labour force. It probably would become a large net exporter if foreign currencies were freely convertible into dollars. As it is, an important problem confronting the United States is how to bring about an expansion of industrial output sufficient to absorb into the working force the workers released by improvements in agricultural technology.

The projected increase in American requirements for agricultural products for 1975 as compared with consumption in 1950 is 40 per cent (42 per cent for foods and 25 per cent for non-food products).

To satisfy these requirements from U.S. sources, agricultural output would have to increase 1 per cent per annum cumulatively. The average annual increase achieved during the decade 1939-49 was 2.75 per cent with a 10 per cent decline in the agricultural labour force.

The 40 per cent increase in U.S. agricultural output assumed to be required by 1975 ought to be rather easily accomplished with a smaller labour force than now (roughly 10 million). Indeed the agricultural labour force will have to decline if farm incomes and the income of farm workers are to increase commensurately with incomes projected for the rest of the population. Nor will much new land have to be brought into cultivation. The projected increase of output is what is conservatively possible on existing land if techniques now known are more widely used and if appropriate changes are made in current patterns of land use.

There is not much doubt that at existing price relationships American agricultural output could increase over the next quarter century by much more than the projected 40 per cent. If foreign demand were available it is probable that an expansion of exports rather than a reduction of the farm labour force would be the alternative chosen.

This evaluation of agricultural possibilities can be applied without much modification to the Canadian situation. The possibilities of large expansion of agricultural output also exist for those other traditionally great exporters of primary products, Australia and Argentina. If these possibilities are not realized it will be largely because of national policies unfavourable to primary production. One does not have to accept completely Colin Clark's characterization of the Australian 'paranoiac national preconceptions towards urbanization and industrialization'[6] to agree with him that Australia's contribution to her own impoverishment and that of the rest of the world is an important one. A study of what has happened to national income *per capita* in Australia since 1900 when it was nearly as high as that prevailing in the United States should be enough to induce sobering thoughts in the minds of most enthusiasts of industrialization. As for Argentina the recent conclusions of a British journalist that 'Peron's gamble on industrialization has brought Argentine agriculture close to bankruptcy without achieving any lasting economic benefits', appears to be not only succinct but accurate.[7]

The rapid rates of increase of agricultural output *per capita* that have been realized over the last decade in the United States and

[6] Colin Clark, 'Halfway to 1960', *Lloyd's Bank Review*, April 1952, p. 3.
[7] Jack Winocour, 'Argentina's Economic Crisis', *Fortune Magazine*, May 1952, p. 95.

Canada and that would be possible, with different domestic policies, in Australia and Argentina, are by no means limited to these countries. Britain and the Scandinavian countries show increases nearly as large as the United States and there have been smaller *per capita* increases elsewhere in western Europe.

All things considered it seems probable that countries that export manufactured products for food stuffs and raw materials could obtain their imports without any markedly adverse change in price relationships if it were possible for them to buy in the cheapest markets and if resources were free to flow into the most productive opportunities. For some materials importing countries, however, lack of currency convertibility will prevent purchase in the cheapest market. And for some materials exporting countries discrimination against primary production will substantially reduce supplies. The net effect of these impediments *could* be a substantial worsening of the terms of trade of manufactured products for agricultural raw materials.

When one examines the list of agricultural raw materials and unprocessed foodstuffs that bulk most largely in international trade (cotton, wool, rubber, jute, wheat, coffee, tea, cocoa, rice, etc.) there appears to be no economic reason why, with continued technological improvement, an expansion of the magnitude necessary to satisfy requirements over the next quarter century cannot be accomplished at declining real costs. A possible important exception is meat and an inevitable exception is timber. On the North American continent until recently timber has been produced and sold at prices very little higher than sufficient to cover cutting and handling costs. Even in western Europe it is doubtful whether timber prices have been adequate to cover the full costs of replacement. As replacement costs come to determine timber prices this situation will change: indeed the real price of timber in the United States has risen sharply over the last decade. This, however, is an exception.

MINERALS

An appraisal of the outlook for mineral raw materials must start from the fact of the overwhelming importance of coal, petroleum and steel (such minerals as sand, gravel and common clays are here excluded from consideration because they are almost everywhere available in unlimited quantities). For any industrial country a ten per cent increase in the real price of coal, steel and petroleum would be much more serious than a 50 per cent increase in the real price of all other minerals taken together.

The consumption of steel in the United States — and in most other

industrial countries — is more than twice as great tonnage-wise as the consumption of the total of all other metals. The next most important metal both in weight and in value is copper, soon to be displaced from this position by aluminum.[8] In recent years the U.S. consumption of copper has averaged around a million and a half tons and the current price is about 25 cents a pound. By comparison the average consumption of ingot steel has been about 100 million tons and the current selling price is 5 to 6 cents a pound.

The President's Commission finds some evidence that during the decade 1940-50, the long preceding period of rather sharply declining real costs of production of minerals in the United States was reversed. This evidence, however, is by no means conclusive. What is much clearer is the fact that over this same period the United States has ceased to be a net exporter of mineral products and has become a large net importer. Furthermore there is no doubt that, given opportunities for expansion of output in the principal minerals producing countries no worse than exist currently, U.S. minerals imports will greatly increase over the next quarter century.

The questions of interest are; what are the technical conditions confronting output expansion in the principal minerals producing countries of the world; are the technical possibilities likely to be realized in the face of increasing obstacles to foreign investment; how seriously would rising real costs of imported minerals affect the prospects of economic growth in the United States and elsewhere?

While reliable data on ore bodies are hard to obtain there is enough information available on measured and indicated reserves[9] to justify the statement that, were resources free to move to lowest cost sources of supply, projected requirements for the principal metals could, without much doubt, be satisfied over the next quarter century at declining real costs.[10] This means real costs at present points of principal consumption and the statement is made with full recognition of the difficulties of access to some of the richer ore bodies. There are one or two apparent exceptions among important metals of which lead may be the most significant. Even in these cases, however, it is difficult to judge whether reported known resources are

[8] Gold is excluded from this discussion of industrial metals.

[9] According to U.S. practice measured ore is ore for which tonnages are computed from the results of detailed sampling. In no case are the stated limits 'judged to differ from the computed tonnage or grade by more than 20 per cent'. 'Indicated ore is ore for which tonnages and grade are computed partly from specific measurements — and partly from projection for a reasonable distance on geologic evidence.' 'Inferred ore is ore for which quantitative estimates are based largely on broad knowledge of the geologic character of the deposit and for which there are few, if any samples or measurements.' Report to the Commission from the United States Geological Survey and Bureau of Mines, Vol. II.

[10] The information on reserves is summarized by countries in a set of tables in Ch. 11 of Vol. I. It is considered in more detail in Vol. II which deals with specific materials.

anything more than working inventories that can and will be extended as occasion warrants. When, furthermore, one takes account of the fact that most of the mineralized areas of the world have been nowhere near as intensively explored as the mineralized areas of western Europe and the United States and of the further fact that the detection of ore bodies by surface outcroppings is even now giving way to new techniques that give promise of locating deposits without benefit of outcroppings, this optimistic view is reinforced. At some stage an inescapable shortage of minerals may threaten but there is no evidence that this impends during the period in question. The difficulties and obstacles that may, over the next quarter century, substantially raise the real costs of meeting mineral requirements are not to be attributed to the 'niggardliness of nature'.

These obstacles are rather the result of attitudes and policies in resource countries, the uncertainties arising out of the cold war and the general state of military insecurity, and the lack to date of constructive suggestions, on the national and international plane, as to how these difficulties may best be overcome. Most of the production of minerals for export is in the hands of a few large petroleum and mining companies. The resource countries are either independent states many of whom discriminate heavily against foreign capital, particularly with respect to the development of natural resources, or the colonies of European powers many of whom tend to discriminate against all except the nationals of the metropolitan country.

The Commission conducted an interesting and illuminating survey of the opinions of the principal U.S. companies engaged in foreign mining and petroleum operations, some of which are made available in the Report. It is clear that the main obstacles encountered by American companies are not so much connected with the division of earnings between company and source country as with the imposition of conditions adversely affecting efficient operations, with limitations on the repatriation of earnings, and, above all, with uncertainty as to whether conditions under which operations are conducted, though not very good today, may not become very much worse tomorrow.

It is the opinion of the Commission, fully shared by the writer, that the development of mineral resources by western European and American capital and enterprise and with growing local participation is usually the most efficient way of expanding output. Furthermore, as the author has argued elsewhere,[11] such an expansion is not only compatible with general economic development but can be of very

[11] E. S. Mason, 'Raw Materials, Rearmament and Economic Development', *Quarterly Journal of Economics*, August 1952.

great assistance to such development, as the Venezuelan experience indicates. Not only is foreign capital, on appropriate terms, available for mineral expansion but it brings with it extensive auxiliary sources such as port facilities, roads and power plants, and, in distinction to many types of agricultural expansion, does not involve a diversion of large quantities of local resources.

The Commission's proposals for government action to overcome obstacles to foreign investment in resource development run along somewhat conventional lines; extension of investment treaties, negotiation in special cases of executive agreements applicable to minerals productions, tax concessions by the American government on foreign investment income, bilateral tax treaties, insurance against expropriation and inconvertibility of earnings, reduction of tariffs and other barriers to imports of materials into the United States. Frequently action by investors themselves can be of greater assistance in securing a welcome from source countries than anything government can do for them. A number of instances are cited of encouragement by American companies of local investment and management participation, the initiation of extensive training programmes and of arrangements looking towards a transfer of ownership to the nationals or the government of the source country after a period of time.

It seems quite possible, however, that the application of the full range of proposals here envisaged, both for investors and for government, including, in the case of strategic and critical materials, long-term government purchase contracts and financial assistance to American mining companies operating abroad, may not be sufficient to bring about an expansion of minerals production sufficient to meet projected requirements. In a number of areas effective minerals development waits on general developmental measures such as the provision of railway and road systems, electric power facilities, housing, port development, etc. The International Bank and, to a smaller extent, the Export-Import Bank are available in this area as lending institutions. And, despite the smallness of their contribution to date in the minerals field, the technical assistance programmes have large potentialities. Since the President's Commission was exclusively concerned with materials problems, international public lending and technical assistance in support of general development are given somewhat peripheral treatment in their Report. It seems possible, however, that a satisfactory solution to the problem of raw material expansion in the underdeveloped areas of the world may not be found outside the context of a satisfactory programme of general economic development.

Concerning the overall minerals situation it is the writer's opinion, based primarily on the data made available in this Report, (1) that there are no insuperable technical obstacles to meeting free world requirements over the next quarter century at declining real costs, and (2) that if, on the contrary, real costs increase sharply it will be primarily the consequence of mistaken national policies and of a failure to devise institutional and international arrangements adapted to the contemporary situation.

Assuming a pessimistic outlook, what would be the effect on the growth rates of industrial economies of increasing real costs of mineral raw materials? If iron and steel (or iron ore) coal and petroleum are excluded, the effect even of a substantial rise in real costs could not be very serious. The value of the consumption by industrial countries of all other minerals is a small percentage of national income. The inclusion of steel, coal and petroleum makes a substantial difference. And, of course, if industrial countries confronted rising real costs of agricultural products, including foodstuffs as well as of mineral raw materials, *per capita* growth rates could well be negative.

Focusing attention here on minerals it is evident that differences in the vulnerability of various industrial economies to increases in real costs of materials from current sources are very great. These differences depend on the relative availability of substitute resources, of technologies capable of exploiting these resources and on institutional flexibilities within the various economies. The United States quite clearly is in a relatively good position to protect itself against the adverse effects of rising real costs of minerals from current sources. There exists within the borders of the United States very large deposits of lower grade iron ore that could be used with a relatively small increase in the cost of producing pig iron; extensive deposits of oil shale that will come into use if and when the real price of natural petroleum increases by 20-25 per cent: very large quantities of coal and more than adequate supplies of the different materials required for the expansion of various increasingly important types of synthetic products. Improved technology, moreover, offers large possibilities of materials saving in the redesign of end products, the more extensive reuse and recovery of scrap, and the development of alternative sources of supply and of substitutes.

This relative invulnerability of the United States to rising real prices of materials from existing sources could have rather diverse consequences. A sharp and sustained rise in these prices could take the U.S. out of competition with other industrial countries for the available supplies of materials thus, perhaps, alleviating Mr. Bevan's

fears that this country, having exhausted its own natural resources is about to exhaust the natural resources of the rest of the world. On the other hand, such a shift would not only intensify the 'dollar shortage' but would lessen that economic interdependence among countries of the free world on which the hope of effective intergovernmental co-operation so largely depends.

ENERGY RESOURCES

The free-world situation with respect to energy resources is very much the same as it is for mineral raw materials. When full account is taken of the substitutibilities of coal, petroleum, natural gas and hydro-electric power and the flexibility of conversion of one energy source into another, there are no overwhelming technical obstacles to the satisfaction of projected energy requirements at real costs that — if not declining — at least need not rise very much. Here again if various countries encounter sharply rising energy costs it will, in the main, be the result of a combination of barriers to trade, obstacles to the flow of investment funds, military insecurity and the failure to devise international arrangements adequate to meet these difficulties. Furthermore, the economies of different countries exhibit a wide range of vulnerability to rising energy costs.

As compared with other industrial countries an extraordinarily high percentage of American energy requirements are met from petroleum and natural gas. Over the next quarter century this percentage is expected to increase. During the period since the war about 40 per cent of U.S. energy and heating requirements has been met by coal, roughly 35 per cent by petroleum, nearly 20 per cent by natural gas and not over 5 per cent by hydro-electric power. This contrasts with the situation in 1900 when roughly 90 per cent of the energy and heating requirements of the United States were supplied by coal.

American energy requirements are projected to double by 1975. Although coal production is expected during this period to increase from something over 500 million tons to about 900 million, the share of the energy burden assumed by coal is projected to decline to less than 40 per cent. The position of petroleum is expected to remain about the same, natural gas will carry an increased burden and hydro-electric power will, perhaps, decrease slightly.

If these expectations are realized it is probable that the real price of natural gas will rise somewhat but not enough to check the expansion of demand of this extraordinarily convenient fuel. The real price of petroleum may also be expected to increase somewhat but

any increase will be limited by the availability of petroleum imports and of petroleum from shale and, later, coal. On the other hand there is no technical reason for expecting an increase in the real price of coal and since, for industrial purposes, coal and fuel oil are closely interchangeable, it seems likely that American industry will be able to count on fairly constant energy prices for the indefinite future.

The principal uncertainty in the U.S. energy situation concerns the future of natural petroleum production. For the last quarter century, despite a three-fold increase in petroleum consumption, U.S. measured reserves have increased sufficiently to guarantee a 12-14 years supply at current rates of consumption. The accelerated rate of discovery, however, has not prevented the United States from becoming a net importer to the extent of 300 million barrels per annum and it seems highly probable that not only the volume but the percentage of domestic consumption imported will increase. U.S. dependence on imports of petroleum could increase very greatly. Whether or not this happens depends not only on domestic production of crude but on what happens to the price of both imports and domestic production. At a price not much higher than the current price of crude the production of oil from shale will become possible and it is estimated that the upper limit of shale-oil production in the United States is not less than 2½ billion barrels per year which is somewhat greater than total current consumption. Beyond that there are the very large coal resources of the United States available for synthetic petroleum production.

There is, then, nothing in the present outlook that argues for a large increase in the real price of petroleum in the United States. The chief question concerns the share of U.S. petroleum requirements to be met by domestic natural production, imports, shale oil, or synthetic oil from coal. The main energy problems confronting the United States are concerned with ways and means of meeting the suddenly imposed conditions of total war. The steadily increasing requirements associated with economic growth can probably be satisfied at little or no increase in real costs.

The energy outlook for Britain and for western Europe, on the other hand, is clouded by the almost complete dependence of the area on imported liquid fuels, the lack of indigenous supplies of natural gas, and the probability that large increases in coal production, if forthcoming at all, will be at increasing costs. Certain countries, notably Norway, Sweden and Switzerland, are adequately protected by the availability of hydro-electric power. Others, including Denmark and Austria, as noted in the Economic Survey for

Europe in 1951, are currently pinched by the high price of imported coal.[12]

The small but important amounts of coal now imported from eastern Europe are likely to be absorbed in the near future by internal development. If western Europe becomes increasingly dependent on imports of coal from the United States the landed price may well be reduced from current high levels but it can hardly fall below the highest cost European production.[13] Increasing dependence on American output is bound not only to increase the total cost of meeting European coal requirements but to confront those countries particularly dependent on this source with a difficult payments problem.

A worsening of the western European energy situation can only be avoided if the area can count on Near Eastern production of petroleum and, possibly, of natural gas. The President's Commission projects a tripling of the petroleum requirements of western Europe and Britain by 1975. There are no technical reasons why an increase even more rapid than this could not be attained without encountering rising real costs. The real problems have to do with difficulties confronting capital expansion in the area and with payments questions. It is furthermore technically possible to pipe large quantities of natural gas, now unutilized, to western Europe at costs substantially less than the current price of manufactured gas.[14] In a situation, however, where an expensive installation could be rendered useless by any one of the countries in which it is located or easily overrun in case of war, it is unlikely that the required capital investment will be forthcoming.

TECHNOLOGY AND RAW MATERIALS

Surveying the raw material outlook as a whole, including agricultural materials and foodstuffs, mineral materials, and energy sources, the data assembled by the President's Commission suggest strongly to this observer that the materials requirements associated with a doubling of the real incomes of free-world countries could technically be met over the next quarter century at declining real costs. Nor does this conclusion depend on impossible assumptions concerning the mobility of resources, freedom of trade and exchange convertibilities. It *does* require a moderation of national policies now oriented towards self-sufficiency, a greater willingness on the

[12] *Economic Commission for Europe*, Geneva, 1952. Ch. 6. The European Coal Problem.
[13] Ibid., p. 153. The E.C.E. suggests that, 'if the trade were organized on a permanent basis', the cost of American coal landed in Europe might be reduced to $15 from present prices which, 'on rush orders' sometimes reach $25 a ton.
[14] Cf. Vol. I, Ch. 21.

part of primary producing countries to provide a hospitable reception to foreign capital, and the working out of international arrangements looking towards the provision of adequate lending and technical assistance.

The establishment of conditions conducive to economic growth in both industrial and primary producing areas involves issues that extend beyond the sphere of raw materials production. Even within this narrow sphere the Report under consideration is not unduly venturesome particularly in its treatment of international possibilities. But it is important to distinguish those factors bearing on the real costs and terms of trade for primary products that come under the Ricardian heading of 'the natural and irreplaceable qualities of the soil' from those that are amenable to change by national policy and international arrangement.

If adequate policies and arrangements are not forthcoming the relative vulnerabilities of industrial countries to rising raw materials costs will depend largely on technological potentialities in relation to alternative materials sources at the country's disposal and on the flexibility of institutions to shifts in material sources and uses. The possibilities of materials substitution in the United States are very large and the President's Commission devoted substantial attention to the relation of technological developments to the raw materials problem.[18]

Improved technology holds possibilities for commercial extraction of low grades ores, the 'recycling' of materials currently going to waste, the production of substitutes and synthetics, the redesign of equipment away from the use of scarce materials. Of perhaps equal importance is the devising of ways and means of bringing economically substandard operations up to the level of the best. A consideration of both problems; how to overcome institutional obstacles to efficient operations, and how to secure a desired rate of technical improvement in the extraction and use of materials, raises important questions concerning the role of the price system and the sharing of responsibility between government and business.

The 'proper' answer to these questions will vary markedly among countries. The President's Commission prescribing for American conditions see changes in relative prices as the principal allocator not only of labour and capital in raw materials production but as indicator of the areas in which research expenditures are needed. 'But', it is asserted, 'to believe in a minimum of (Government)

[18] One of the sections of Vol. I is specifically concerned with technology; the treatment of particular materials in Vol. II and Vol. III pays particular attention to technological possibilities; the whole of Vol. IV is devoted to the reports of various research departments and foundations on the technology of materials.

interference is not to believe that this minimum must be set at zero.' In fact the American government already takes a large hand in raw materials production and public policy will have an important part to play in any satisfactory meeting of U.S. materials requirements over the next quarter century.

Research conducted under Government auspices has made a major contribution to the phenomenal increase in American agricultural productivity over the last decade. Moreover the Department of Agriculture has developed, in its Extension Service, a highly effective means of transferring the results of research to the farm. Despite these achievements the divergence between what is produced and what could be produced on the same land and with the same man power with better farm plans for the use of land, optimal application of fertilizer and equipment, is very large. In recent years Governmental assistance in the preparation of production plans for individual farms has substantially increased agricultural output; a more extensive use of fertilizer and equipment may require not only instruction but improved credit facilities. In any case the removals of obstacles to the use of known techniques can make an important contribution to meeting U.S. requirements for foodstuffs and agricultural raw materials. Of necessity Government bears the main responsibility for this accomplishment.

The management of forest properties provides another example in which the incentive to private enterprise provided by changes in relative prices can be usefully supplemented by government action. The first requirement, certainly for sustained yield management of wood lands is a real price for forest products sufficient to cover the full cost of reproducing these products. But the required price increase, per unit, can be more or less depending on how effective a use is made of the whole product of lumbering operations. Here the work of government financed and sponsored forest products laboratories in devising new uses for timber and waste products has been and will continue to be important. Furthermore since two-thirds of the wood lands of the United States are in holdings too small for efficient operations, economies of scale are likely to be realized only through institutional changes that facilitate the grouping of properties or their co-operative management. Even with these changes government assistance in the development of effective cutting and seeding practices is necessary for efficient management. It is as true of forest as of agricultural land that the meeting of expected requirements depends as much on the spread of known technology as it does on new methods. In both, government has an important role to play.

Government action in the field of minerals production has taken

the form of geological surveying and mapping, direct exploration for a limited number of 'strategic' materials, the provision of a special set of laws relating to the exploration and development of mineral properties on public lands, the granting of special tax incentives, research into new sources and uses of materials, and, on a limited scale, the provision of financial assistance to small mining operations. In the minerals area, as in others, chief reliance is placed on private enterprise guided by the operations of the price system. But again business functions within the context of important governmental limitations and direct participation. And the extensive use of tax concessions for oil and mining operations certainly involves a substantial modification of the price system.

Concerning public action designed to spread the use of existing technology and the development of new methods in the minerals field two examples will suffice. The first relates to the present laws governing the exploration for minerals on public lands which have survived practically intact from the days of the 'gold rush' in 1849. Not even well adapted to pick and shovel operations depending on the discovery of outcroppings they are totally unsuited to new techniques that search for minerals underground. The leasing system that permits exploration concessions over large tracts, now used in the United States in the development of petroleum, sulphur and potash can be and should be extended to other minerals. If and when it is, there is some reason to believe that the success attending the search for oil may be approached for some other minerals.

The second example has to do with recent work by the Bureau of Mines on the use of substitute materials. Practically all of the American investigation to date of the production of oil from shales has been conducted by the Government. When and if the United States is confronted by a declining rate of discovery of natural petroleum this work will be well advanced. The Bureau of Mines has developed a method of extracting manganese from slag that gives promise of providing a partial substitute for imports in which the United States is currently almost entirely dependent. The work of the Bureau on the concentration of commerical grade iron ores from low-content taconites and on other materials problems had also been effective.

These examples of public action directed towards the removal of obstacles to the use of existing technology and to the development of new methods in agriculture, forestry and mining must not be allowed to obscure the central dependence in the United States — in the writer's view, a proper dependence — on the function of private enterprise under a relatively free price system. They may serve, however, as a caution to British readers to accept with a grain of salt

the common export view of the American economy as a free enterprise system operating in a political void, a view that the Report here under consideration does not, perhaps, altogether successfully escape.

THE INSTABILITY OF RAW MATERIALS MARKETS

It is impossible to conclude a discussion of raw materials problems — even one as brief as this — without some mention of the relative instability of raw materials prices and the supposed consequences. Many competent observers consider instability to be *the* materials problem. Those who espouse this view will complain — and from their point of view rightly — of the scanty attention paid this question in this Report.[16]

There is, of course, no doubt concerning the fact of relative price instability, a fact redocumented by a recent United Nations report.[17] Nor is there doubt concerning the hardships inflicted by a sharp fall in prices on raw materials producers or the severity of payments difficulties encountered by both importing and exporting countries as a result of the gyrations of these prices. The behaviour of raw materials prices and its consequences since the beginning of the war in Korea are too freshly in mind to be ignored. Despite these facts, about all the President's Commission has to suggest is a more responsible management of stockpile procurement, avoidance of restrictive commodity agreements in favour of multilateral contracts of the type of the International Wheat Agreement, and a tentative espousal of international buffer stocks on an experimental basis.[18]

There are, of course, strong equity considerations favouring government action to relieve the distress of producers, particularly of agricultural raw materials, occasioned by declining demands to which no effective supply adjustment can be made. Many countries have taken such action and it frequently takes the form, as in the United States, of price supports. The Commission, however, was not primarily concerned with the broad range of questions here at issue. Price instability was considered relevant to the Commission's assignment only to the extent that the long-run adjustment of raw materials supplies to requirements was adversely affected thereby.

It can certainly be argued that expectations of a relatively stable price trend will bring forth investment at lower costs per unit of investment than will expectations of wide price fluctuations around

[16] Cf. Vol. I. Ch. 15, 'Reducing Market Instability', and a technical paper in Vol. V, 'Stockpiling Materials for Security'.

[17] Economic and Social Council, 'Relation of Fluctuations in the Prices of Primary Commodities to the Ability of Underdeveloped Countries to Obtain Foreign Exchange', N.Y., 1951.

[18] The Commission, of course, favours international raw materials allocation during a period of shortages such as we have witnessed since the beginning of the Korean War.

this trend. It is furthermore, reasonable to expect, if relative price stability is the product of a lessening of fluctuations in quantities taken off the market, by the operations, say, of an international buffer stock programme, that output per unit of investment would be increased. Both changes would work in the direction of lower real costs, over time, of primary production. The main questions are, would buffer stock operations produce these price expectations and, if so, at what level?

Much more important than these hypothetical reactions of investors to a stabilization of raw materials prices are the demonstrated reactions of governments to an absence of stability. The real argument for stabilization is that, without it, trade and production restrictions that almost invariably outlast the crisis which evokes them are likely to be imposed by governments.

It is, however, open to question how much of the instability of raw material markets is amenable to purely commodity solutions. Certainly the largest contribution that can be made to evening out the demand for primary products will come from the domestic income and employment stabilization programmes of the principal materials importing countries. These programmes and policies will not eliminate recess of the 1949 variety nor will they prevent rearmament booms of the type of 1950-52. There is, though, reason to believe they not only can but will prevent a recurrence of the experience of the 1930s. If so, commodity solutions to the problem of instability become less important but more practicable.

The President's Commission sees substantial merit both in multilateral contracts of the wheat agreement variety and in international buffer stocks.[19] Both types of arrangements leave price making forces relatively free and seek merely to confine price fluctuations within a limited range. If a buffer stock management enjoys substantial freedom of action and if all that needs to be considered is the probable reaction of individual buyers and sellers to price changes, the elimination of extreme price fluctuations through a proper adjustment of floor and ceiling prices should not be too difficult. Nor would the operations of buffer stocks in the face of fluctuations of the magnitude of 1949, or even of 1938, require the maintenance of very large stocks. It is of the essence of the problem, however, that the clients of the buffer stock management are governments, and,

[19] The Commission warns, however, with respect to the wheat Agreement, that 'Since the world price has been the maximum agreement price for the entire life of the agreement, the exporting countries have borne the full costs of stabilization. Since the major exporters (the United States and Canada) enjoy a strong balance of payments situation, this has not given rise to serious problems. The real test would come when importing countries many of whom are in weak international financial positions, were faced with the obligation to purchase at agreement prices above the world price.'

moreover, of governments frequently besieged by organized and highly vocal economic pressure groups. Whether in boom times producing countries would willingly see their export prices limited to a fixed ceiling via the competitive selling of the Buffer Stock Authority and whether consuming countries, would witness with pleasure the competitive bidding up of the price of their imports by the same Authority, is open, at the least, to serious question.

Despite these difficulties it is the author's view that buffer stocks hold substantial promise of achieving a measure of stability and that the President's Commission might well have taken a somewhat more positive position. On the other hand it is difficult to accept the optimistic view, frequently advanced, concerning what can be accomplished by buffer stock operations.[10] International experience with this institution has been negligible and the difficulties attendant on the negotiations and administration of other types of international commodity arrangements do not suggest an easy path for this one. There is, furthermore, a special consideration that necessarily impresses an American Commission recommending action in this field. The significance of the United States as a raw material importer and exporter coupled with the probability that they would have the privilege of contributing most of the financing required to maintain inventories, would saddle this country with an unavoidable responsibility for decisions to accumulate or dispose of stocks. Such decisions are bound to be displeasing either to producing or consuming countries. This is not an adequate reason for avoiding international responsibilities but it suggests an experimental approach pending a further assessment of the character and magnitude of those responsibilities.

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[10] e.g. W. Arthur Lewis in his excellent *Economic Survey 1919-1939*, (p. 174) goes so far as to say: 'The creation of international buffer stocks would be the greatest single contribution that could be made to international stability. If the machinery for operating such stocks had existed in 1929 there would have been no major slump, much higher standards of living all around, and no second world war.'

SHORTAGE OF CAPITAL

Some Causes and Effects

by N. I. Momtchiloff

OUTLINE OF DEMAND

Scarcity of capital, in one of its more tangible forms — shortage of working capital — has been widely felt throughout industry and trade for many months past. Little guessing is needed about the reasons. Insufficient building up of reserves owing to the operation of wartime excess profit tax and post-war taxation of incomes and profits; rising costs of materials, labour, services, building, plant, repairs and maintenance; financing of expansion, overhauls and re-equipment out of current income or with bank money; somewhat laxer handling of overheads while trade was booming — all these and no doubt some other causes have contributed, in varying degrees and different ways, to the growing insufficiency of companies' working capital and its gradual tying up in assets which, for all practical purposes, cannot be made liquid without great inconvenience. The tying up is no less important than the shrinkage.

While production and sales have been steadily mounting since the war, working capital has not generally kept pace with this rise. The series of public company accounts analysed periodically by *The Economist* show a gradual decrease, since 1949, in the ratio of liquid resources (cash plus marketable securities) to both total assets and current liabilities. On the average, however, total cash and near-cash held by public companies still shows a higher proportion to bank overdrafts and creditors, to total assets, and to net worth, than would be revealed by a similar analysis of private companies' accounts. The discrepancy is striking when *The Economist's* figures are compared with those published by the British Bankers' Association in their Memorandum to the Royal Commission on the Taxation of Profits and Income. This may be partly due to important differences in the methods of sampling, but when allowances are made for factors of this kind, it is difficult to avoid the conclusion that private companies' liquidity has deteriorated far more than that of the larger public companies. The conclusion is borne out by the study of a quite different sample of private companies' accounts.

In usual practice a substantial part of companies' working capital is provided by their bankers, in the form of loans, discounts or overdrafts. It can be said without hesitation that the banks have done their full share of this job since the war. But there are well-defined

limits beyond which the banks cannot go. The credit they give must be related to the borrower's own resources in capital and reserves. In the case of many private — and some public — companies, flexibility in bank lending was stretched rather generously about mid-1950 when costs and prices shot up again under the impetus of the war scare. A great deal of stocking up took place at high and mounting prices, between June 1950 and the end of 1951. Working capital was more urgently and extensively needed than at any time since 1946. When the Government applied the screw to the money market and bank lending, most industrial and trading borrowers had probably obtained from the banks all they could reasonably hope to get under conditions of brisk demand and steady profits. But demand for a widening range of goods began to flag, prices weakened and prospects darkened just at the time when the demand for capital, particularly working capital, was at its peak.

Although interest rates and lending terms in general became stiffer, new issues by a number of public companies of high standing were absorbed without much difficulty. Nevertheless, cool reception of a few well-sponsored new issues gave a clear warning to the market that the willingness of investors to take up large slices of new capital was fading. A number of medium-sized and smaller public companies remain in the queue swollen by the massive capital requirements of the nationalized industries.

Private companies' access to the capital market has always been handicapped by circumstances connected with their own constitution and traditions. Their shareholding is confined to a closed circle; their shares are not quoted and cannot be sold easily outside that circle. As they do not publish accounts, potential investors know little about the state of their affairs. The cost of small public issues can be heavy, sometimes very heavy indeed. Current observation confirms that most of present shareholders in private companies, particularly those of them having a part in the control and management of their business, are unable personally to raise enough money for subscribing to new shares. Not a few of those who could afford this seem rather reluctant to expand the permanent capitalization of their companies at present inflated values. Holders of substantial parts of their companies' equity are naturally keen on maintaining the existing control of voting power. These psychological factors are of considerable momentum when private companies are deciding whether to increase their capital. In many cases redeemable loans or preference shares appear to directors as more convenient methods, even though the dangers inherent in high prior charges at fixed interest are clearly understood and the resulting increase in the tax

burden to the ordinary shareholders fully appreciated. The stronger motive seems to be the fear of parting with any substantial slice of the vote-carrying capital.

There are difficulties and inhibitions on the part of potential outside investors also. Most of them are not really interested in acquiring minority holdings of ordinary shares in private companies since it can be very hard to sell such shares in the market. Profit tax and less confident expectation of future profits have undoubtedly stiffened the reluctance of the rare outside investors who might have been tempted to buy such ordinary shares either 'for keeps' or for a capital profit.

How much of the capital in demand is for fixed assets and for working capital? This is a question of great practical importance, especially at the present time; but there can be no answer to it in absolute terms. All that could be done with some usefulness would be to watch the continuous shifts in either direction. A recent study of some 1200 actual applications, mainly by private companies, between October 1949 and the end of September 1951, seems to suggest a rough proportion of about 60 per cent for working capital and 40 per cent for fixed assets.

As the table below shows, there have been fluctuations, over the period; but their significance might be blurred by a consistent bias in the sample. Later information covering the first quarter of this year points to a further increase in the demand for working capital.

DEMAND FOR FIXED AND WORKING CAPITAL

	By number of applications		By amounts applied for	
	Fixed Assets as % of total	*Working Capital as % of total*	*Fixed Assets as % of total*	*Working Capital as % of total*
October 1st, 1949 to March 31st, 1950	38.4	61.6	35.5	64.5
April 1st, 1950 to September 30th, 1950	43.7	56.3	45.0	55.0
October 1st, 1950 to March 31st, 1951	35.2	64.8	29.1	70.9
April 1st, 1951 to September 30th, 1951	39.2	60.8	35.9	64.1
	39.4	60.6	36.5	63.5

Note.—Owing to a fairly large number of borderline cases and to the approximate nature of many applicants' estimates, these figures should be considered as broad indications only.

A characteristic feature of the demand for fixed assets is that, in a great number of cases, its satisfaction can be postponed: some projects of expansion or new ventures can be simply shelved. New buildings and machinery are expensive; permits take a long time, and there is no certain date of completion or delivery of either plant or premises; the final cost of both has become a matter for guessing rather than for businesslike budgeting. The stimulus of 40 per cent initial depreciation allowances has disappeared. Confidence in the longer-term profitability of investment has been somewhat shaken by growing apprehension of consumer resistance, foreign competition and approaching saturation of accumulated demand for many kinds of goods. Borrowing terms have become harder. When the long-term estimates of profitability are weighed up against more pressing needs to finance stocks and work-in-progress or to reduce bank loans and overdrafts, priority is bound to be given to the immediate issue.

Increasing numbers of private companies are confronted with financial worries of yet another kind which, as *The Economist* warned us two years ago, are putting considerable strain on the ability of industrial concerns to raise fresh capital for plant and building. This is the vexed question of death duties. It is no use arguing that the provision of funds to prevent the splitting up and dispersal of certain shareholdings is not the responsibility of the company but of its shareholders. In actual practice the borrowing capacity of many private companies is seriously affected in various indirect but no less tangible ways. And the number of such cases will be increasing in the near future.

Government restrictions on investment, and more especially frequent changes in the scope and direction of these restrictions, are also playing their part in keeping some demand for capital away from the market. Company directors have learned a few lessons in the last three or four years. They know that, for certain capital projects, it would be wasting time to apply to the authorities, and for others, when all official hurdles had been cleared, the general conditions of trade might be quite different or Government policy might change in some important respects. Tiresome and complicated formalities are, in a way, less upsetting for the entrepreneur's long-term plans because they have become a permanent feature of business reality; changes in Government policy remain unpredictable.

The combined effect of these causes and circumstances is that, at the present moment, demand for working capital is probably heavier and more urgent than that for fixed capital. A varying part of total demand is kept back and piling up. The rising cost of

borrowing is likely to add to the bulk of postponed projects, particularly in cases where trade has become less profitable. Gradual depletion of heavy stocks and lower cost of new purchases of some materials might lead to some decrease in both the amount and urgency of demand for working capital. On the other hand, there are many cases of medium-sized and large companies where work and expenditure have already started on projects of plant and building expansion, contracts have been entered into, and temporary finance obtained from the banks or other short-term lenders on the understanding that it will be repaid as soon as additional share capital can be raised. Rearmament work is also compelling industrial firms — large and small — to expand their producing capacity. The steadily mounting capital requirements of nationalized industries — probably larger in the aggregate and less inhibited than could have been the capital projects of the individual companies taken over — add substantially to the grand total of demands to be met in the immediate future. Earlier this year, this total was tentatively estimated at about £650 million for the private sector, and about £950 million for the Government sector (including, for the purposes of that calculation, the capital requirements of the Electricity, Gas, Water, Coal, Steel and Transport industries). Even if the estimate were near the mark — which it probably was not — it would be of very little practical value by now. Many things have changed since last spring, and some more important changes may be impending.

SOURCES OF CAPITAL

The main sources supplying capital to trade and industry are well known. Usually the most important of them is the accumulation of profits, after tax, ploughed back into businesses, or 'corporate savings' as they are called in the White Papers on National Income. This makes it all the more necessary to exclude purely paper profits from the computation of corporate savings. Valuation of stocks and work-in-progress plays a major part in striking profit and loss accounts. It is clear that when prices are rising continuously over a number of years, there will be a steady increase in most companies' book profits. An elementary — though not officially recognized — rule of business management is that adequate provisions must be made against profits largely based on stock appreciation. Although the adequacy of such provisions may be difficult to define and carry out in practice at times of wide fluctuations, it is both possible and practicable to make these provisions substantial when book profits are high. There can be two main obstacles to the observance of this

first principle of sensible management: the one is directors' improvidence; the other is short-sighted taxation policy. Hairsplitting controversy about the technical aspects of the matter is beside the point. And the point, a crucial one, is that if provision for stock appreciation is taken away by taxes, while depreciation of fixed assets is also subject to heavy tax, corporate saving is bound to come to an end. If a proof based on official figures is still needed, it can be found without much effort in the White Paper on National Income. As the City Editor of the *News Chronicle* explained in a recent note based on these official figures, when stock appreciation is subtracted from the £774m. estimated corporate savings for 1951, there is very little genuine saving left. The gravity of this state of things needs no stressing when it is discussed in business circles. But it still remains to be made plain to the vast number of people who do not seem to realize what its inevitable outcome will be in the very near future.

To put it as soberly as possible, if this major source of capital should run dry, no workable substitute could be found for it in an economy largely based on private enterprise. It takes a great deal of wishful credulity to believe that what trade and industry fail to save can be made up by Government saving. In a remarkably lucid study published in the June 1952 issue of the *District Bank Review*, Mr. J. R. Cuthbertson explains how savings by the Government are passed back to the private sector of the economy. When a budget surplus is used for the repayment of Government borrowing from the banks, the cash so provided can serve to increase bank lending to trade and industry and also to purchase gilt-edged securities from the public — within the narrow limits of bank liquidity ratios. It is common ground that bank advances do not provide long-term capital, least of all under the present conditions of the money market and Government policy on credit and investment. The ultimate effect of the transfer from Government savings to private investment thus boils down to supplying present holders of Government securities with funds they *might* be willing to invest in trade or industry. The probable scope of such inducements will be discussed further below; but it can be said straight away that this is unlikely to replace the corporate savings nipped in the bud.

Personal savings are yet another source of capital reduced now to a mere trickle. The White Paper on National Income estimates the total of personal savings and provisions for stock appreciation at £95m. for 1951, £87m. for 1950, and £119m. in 1949. It is not possible to say how accurate may be estimates of this kind. What is known about the net additions to small savings over the last three

years seems, however, to point in the same way. As to actual savings kept with the banking system, the darkness is complete. Even if some information were available on the division of bank deposits into business and personal accounts, it could hardly tell us anything about the amount of savings likely to be used for investment. People and business firms are keeping money in the banks for many continuously varying purposes. Changes of mind cannot be registered for statistical ends, at any rate not in this particular field.

Savings with building societies usually have a specific destination — purchase of property. Few of them could be considered as a contribution to investment in trade and industry, although indirectly they may be taking care of a part of the demand for capital that otherwise would have to be met from funds usable for industrial capital investment. The reversal in the net flow of savings to building societies underlines the general downward trend of personal savings by the lower income groups.

Taxation has made people unable and unwilling to save. This statement of the obvious needs some elaboration. Personal earnings which can be allocated to different ranges of income added up to £4015m. in 1938 and £7939m. in 1949, after tax at the respective rates. About 79 per cent of the 1938 total was earned by people making less than £500 a year gross. There was a certain amount of saving in this group; it might have been a pretty large total consisting of small credit balances and holdings of bonds and shares. By 1949 the same income group earned only about 70 per cent of total personal income in the country and, owing to higher taxes and greatly increased cost of living, it was saving much less than before or during the war. If we bring in the £500-£1000 p.a. incomes the distribution becomes even more significant: people earning up to £1000 a year got 86.9 per cent of total personal incomes after tax in 1948, and 87.2 per cent in 1949. This means that the share of the 'better off' income group of over £1000 a year has remained practically unchanged at about 13 per cent of all personal incomes after tax; but its saving power has been steadily decreasing since the end of the war. Taxation and rising prices have pulled many of the 'better off' households down into the ranges of real income where income is entirely spent and past savings steadily depleted. In 1949 about 2,443,000 incomes of £500 to £1000 each, totalling £1375m., had fallen to the level of disposable incomes where there can be little saving for investment in securities, while another 545,000 incomes of between £1000 and £2000 a year, adding up to some £540m., had entered the fringe where saving for industrial investment may now be considered as marginal. The respective positions of all income

ranges have shifted further since 1949. The number of small incomes (under £500 p.a.) has dropped by another 2 million, to 14¼ million, while that of medium incomes (£500-£2000) has gone up by nearly 2¼ million, more than half of them being incomes of over £1000 p.a. before tax.

That 1,220,000 people earning more than £1000 a year each should have been unable to save more than £95 million net in 1951 will be less surprising if it is considered that nearly one million of these incomes were in the £1000-£2000 class which, at the present level of taxes and prices, cannot save much in other forms than life insurance and purchase of dwelling houses. Even less widely appreciated is that fact that the income groups now moving out of the saving and investing community may well be the owners of nearly half the total investments and interest-bearing savings in the U.K. The 94th Report of the Commissioners of H.M. Inland Revenue does not seem to leave much doubt about that: in the financial year 1949-50, taxpayers in the income ranges £135-£1999 p.a. (before tax) collected about 47½ per cent of all income from interest and dividends in the country. The table below shows how this income was distributed between the different groups:

Income from Investment and Dividends, 1949-50
(before tax)

A. *Income Groups*	B. *Group's total gross income in million £*	C. *Group's income from interest & dividends, in million £*	*C. as % of B.*	*Percentage share of group in total incomes from interest and dividends*
£135-£499	5,160	131.9	2.6	19.2
£500-£999	1,638	91.6	5.6	13.4
£1000-£1999	586	101.0	17.2	14.8
£2000-£4999	576	170.4	29.6	24.9
£5000-£9999	227	91.0	40.1	13.3
£10,000 and over	186	98.9	53.2	14.4
	8,373	684.8		100.0

Changes in the saving habits of households with incomes of up to £5000 a year are of particular importance for the supply of capital for investments, not only through the Stock Exchange but into private companies also. A growing part of these reduced savings is now of the 'contractual' type, mainly in the form of insurance premiums, repayment of mortgages, hire-purchase instalments, etc. The steady accumulation of pension funds in public and private

institutions may become yet another source of savings partly available for investment.

The Economist's recent Supplement on British Insurance (July 12th) gives valuable information on the part played in the capital market by the insurance companies whose total assets must now exceed £3500 million, nearly three-quarters of them held in Stock Exchange securities. It can be seen from the tabulated figures of the Supplement that, both in absolute amounts and in proportion to total assets, these companies' investment in gilt-edged securities together with net accumulation of fresh funds has enabled the forty-three companies listed in the table to invest in 1951 some £212 million in other securities. This total includes about £33m. ordinary shares, £28m. preference shares, nearly £39m. debentures, £52m. mortgages and £30m. property, some of it industrial. Between 1945 and 1949 the insurance companies, taken together, have been putting about 30 per cent of their new money into ordinary and preference shares. This was a weighty contribution to the supply of industrial capital during a period when the need was acute. The importance of this source of investment funds will increase further as supply from other parts of the economy tends to decline.

Two other financial institutions are likely also to play an increasing part in bridging the gap left by diminishing supplies of capital from corporate and personal savings. They are the Finance Corporation for Industry and the Industrial and Commercial Finance Corporation. The funds they invest come from the resources the banks can set aside for investment in industry that cannot be done through the existing machinery of the capital market. Since the I.C.F.C. is more particularly organized to meet the capital requirements of private companies by methods adapted to their characteristic features, there seems to be scope for much-needed expansion of investment in that direction.

One should, however, bear constantly in mind the hard fact that, valuable and substantial as may be the supply of capital by the insurance companies and the two corporations, it could not be expected to outweigh the impact of a heavy and prolonged fall in corporate and personal savings. The bulk of capital supply will continue to depend primarily on the direct savings of firms and individuals rather than on the use of residual parts of such savings through the institutional machinery.

INVESTMENT SHIFTS

It may be true that, on aggregate account, sales of existing investments do not alter the total position since every share or bond sold

is acquired by somebody who uses his own or borrowed savings. When, however, things are considered at any given time or — still more important — when there is an exodus of capital as a counterpart of disinvestment, the effects of this ought to be taken into account in examining the current supply position in the capital market. Few informed observers would deny that the steady flow of sales of Government securities acquired during the war or received in compensation for nationalized assets has had a widespread influence on the supply of industrial capital in the last five years. Such sales of gilt-edged securities by business concerns have enabled them to meet some of their capital requirements without going to the market on their own account. In many cases this may be only a respite, since sales of securities have worsened the selling firm's liquidity so that recourse to the capital market will have still to be sought, perhaps under conditions less favourable to the borrower. Speculation in gilt-edged might also have temporarily diverted funds that could have been used for industrial investment.

Shifts of savings and investments must have taken place on a large scale during the sustained exodus of capital from the United Kingdom to South Africa, Australia and other less conspicuous destinations overseas. Between 1948 and 1951, the net capital outflow to Australia may have reached £540 million. The Commonwealth Statistician estimated that not more than £240m. of this was permanently invested, the balance of some £300m. being of a 'possibly speculative nature'. (*Financial Times*, November 17th, 1951.)

According to the 22nd Annual Report of the Bank for International Settlements, £700 million of capital was exported from the United Kingdom to the rest of the sterling area during the same period. The corresponding increase of the recipient countries' sterling balances in London represented an accumulation of short-term resources of no practical use for capital investment in Great Britain: the rapid running down of Australian sterling balances in recent months provides a most instructive example. There can be little doubt that this massive outflow of funds accounts to a considerable extent for the present scarcity of capital in the home market. Another, less direct, cause has been the steady decline in gilt-edged prices which has reduced the proceeds of sales used for subscriptions to new industrial capital issues. Switching from Government securities into private stocks and shares has provided additions to investment funds particularly in cases of 'rights' issues or of attractive types of new industrial securities. But the loss that had to be taken in certain cases of gilt-edged disinvestment has been heavy.

This day-to-day aspect of investment should not be left out of account in watching the supply of capital to the market. Up to the last quarter of 1951 fairly large numbers of people had been buying and selling securities for tax-free capital profit. The money required — when such transactions involved actual payments in cash — came either from disinvestment or from bank advances. Since borrowing from the banks for such purposes became much harder and prospects of easy capital profits considerably dimmer, this fluctuating and unreliable, but sometimes substantial, addition to capital supplies has also been running dry.

This outline of some causes and effects of capital scarcity may be concluded by a more general remark. There are signs of a fairly widespread change of mind among investors — professional and other — about the effectiveness of the hedge that equities were thought to provide against the erosion of values by inflation. The havoc taxes on profit and income are playing with the real capital value of fixed and floating industrial assets, and with the capitalized value of present and expected returns, is putting a strain on investors' confidence and on their readiness to save and invest their savings in industrial securities. Such a change of outlook may have particularly harmful effects on the supply of risk-bearing capital.

LONDON

PRICE POLICY IN A NATIONALLY ADMINISTERED INDUSTRY[1]

by Fred Stones

Much has been written by economists and others in regard to the question of price control in industry. There has, however, been much less public discussion on the problem of price policy. In industries which are free from public ownership or control, it may perhaps be assumed for the purposes of this discussion that in the long-run market conditions will control prices. In a nationalized industry (and in any other form of national administration which carries the right to fix prices) market conditions — except as regards export — may be ignored by the controlling authority if it so desires, the extent of its independence being perhaps governed only by the degree of monopoly it enjoys.

It is, therefore, desirable that price-fixing in these industries should be in accordance with some definite policy — a policy which must be founded on a sound economic basis. To put it another way, the price to be fixed for the products or services of nationalized industries must be *economic prices*. The importance of establishing such a policy cannot be over-estimated because the industries concerned, coal, steel, power and transport, are the basic industries at the root of the whole of the country's economy. Incorrect prices — either too high or too low — will eventually lead to disaster, and the margin of error may be smaller than is generally supposed.

The duty of fixing economic prices appears to be the joint responsibility of economists and accountants. In the following notes the particular responsibilities of each will be discussed in a general way (although there is a considerable degree of overlapping) and the special problems which will arise will be illustrated by the example of the heavy iron and steel industry. This industry has been chosen because of the complexity arising from its many thousands of individual products, and the criticisms which from time to time have been levelled at whatever policy or lack of policy it appeared to favour.

Further, the steel industry has an interesting price history. For many years its prices were voluntarily controlled through trade associations covering many, but not all, products. The industry during this period was subject to fierce continental competition, both at home and abroad, and this was probably the most prominent factor in deciding the fixing of prices. After tariffs were introduced

[1] These notes represent the individual opinions of the writer and not those of any particular company.

in 1932, prices became subject to the over-riding influence of the Import Duties Advisory Committee, who were, of course, advised by a freshly-constituted and more powerful British Iron and Steel Federation.

In these early stages of national price administration, price-fixation was naturally based on the trade associations records, and it is interesting to examine the action which has since been taken to comply with the remit from the I.D.A.C., namely, 'to facilitate such adjustments in productive capacity and *prices* as would place the industry on a *reasonable profit-earning basis*'.

In order to define what is an economic price it is necessary to decide: (i) the cost of a product, (ii) the relative (i.e. compared with a world standard) efficiency of the industry manufacturing it, (iii) what elements should be contained in the profit margin, and (iv) the method of calculating the profit margin.

Items (i) and (iv) may be said to be accountancy matters. The remaining two items are largely for economists to decide in principle, but for accountants to put into practice, and neither responsibilities are likely to rest lightly on those concerned.

(i) *The cost of a product.* Under this heading it is not intended to discuss the problem of the cost to an individual firm, but the ascertainment of a National cost, which may be used as a basis for price-fixing. The pre-requisite for such a cost is a uniform cost system throughout the industry. The history of the iron and steel industry in this respect may be of interest.

A uniform cost system was devised in 1936. Unfortunately it was not made compulsory. The net effect has been that some companies have never used it, whilst at the other extreme other firms have improved and developed the 1936 system out of all recognition. In order to supplement the extremely patchy cost information available in the industry, a specially designed form of monthly cost return was imposed by the British Iron and Steel Federation in the late thirties, designated 'running costs'. These running costs suffer from two great defects: (*a*) large numbers of individual products of widely varying costs are grouped together to give an average cost, and (*b*) manufacturing costs for a monthly period are related to the deliveries of that period. The production time cycle is such that the effect is to relate the costs of manufacture of one group of products against the sales value of what is often a different group, the hope being that in the long-run the variations will cancel themselves out. It hardly seems desirable to allow such an important matter to be left to pious hope. The true facts should be ascertained.

In 1940 the Ministry of Supply (which by then had superseded the

I.D.A.C. as the authority controlling or supervising the industry) decided to collect its own cost information and a further cost return — reconciled with individual Balance Sheets — was instituted and has since been gradually improved. This return is probably on a sounder basis from an accountancy point of view, but it really gives no guide to individual product costs and profits, as the grouping of products is on an even broader basis than that of the running costs.

In the event, price increases have been granted by the Ministry of Supply after the evidence provided by both sets of returns have been examined. The fact that the tools at their disposal were really inefficient was not initially the fault of the Ministry — but both they and the industry must share the responsibility for adequate product cost information still not being available.

The result of this deficiency has been that (apart from a few special cases) price increases have been granted from time to time merely to cover the frequent changes in costs of raw materials, coal, carriage, and wages. The fact is, therefore, that it is generally true that the basis prices for steel products in relation to the national economy are the same now as they were pre-war. Actually, there has even been some deterioration in comparative price levels, because for steel products selling prices are often composed of a basis price, plus an extra for variations in size, quality, finish, etc., and in many instances the 'extras' are still only charged at the pre-war price. If the *extras* charged pre-war were economic they will be uneconomic today, and the relationship between the lower and higher priced products may have altered to such an extent that the consumer will actually find it more economical to purchase the dearer products, where they are alternative. This in turn could result in a different order book necessitating a different balance of equipment at the finishing end of the industry, much of which may not be earning profits. Therefore the effect of incorrect prices in the steel (or any other) industry may well be an uneconomic pattern of development and expansion.

Similarly, if the pre-war *basis* prices were not economic, then today's prices are also uneconomic, and the history of the industry shows that many prices must be unsound. Between the two wars up to the introduction of tariffs, the industry had to face unfair foreign competition in many of its basic products — particularly in semi-finished steels for further re-rolling. This competition depressed the prices of these products to such an extent that complete recovery to an economic level was impossible, for political reasons, when tariffs were introduced. Obviously, the steel industry could not survive indefinitely under these conditions with many of its 'bread-and-butter'

lines either losing money or barely covering costs, and profits had to be made. They were made, and in total the industry looked 'reasonably profitable', but the fact was that the uneconomically-priced products were subsidized by the higher than economic prices charged for other products; and therefore one consuming industry benefited at the expense of another. This state of uneven price lists obviously leads to greater shortage of the uneconomical products in periods of heavy demand than might otherwise be the case; it also leads to coupled bargains by both the manufacturer and the buyer — depending on the state of the market. It does not seem unreasonable to suggest that an economic price should be fixed for *every* product from a nationalized industry. This would at least assist in its rationalization, by tending to direct orders to the most efficient plants, inasmuch as if all products are relatively equally profitable, then there is no incentive to resist orders for which a plant may be eminently suitable, or to scheme for 'a balanced order book'.

It may be that this price situation conceals a damaging effect on the national economy. It has been thrown even more into the background since 1945, because due to a high demand for its products, coupled with much plant modernization, the industry's total profits have increased to apparently high levels, and unfortunately it has become the custom to relate prices to the over-all profits rather than to the results on individual products. In spite of higher production and price increases there are still products which do not 'pay their way'.

Although world events have played their part in producing present conditions, the industry has also contributed because of its lack of a sound uniform costing system; the above very brief history — which must be taken as a broad generality — is evidence enough that the first essential for the fixing of economic prices is a method of arriving at a national cost for each product. As already stated, there are many thousands of individual products in the steel industry, but it is not impossible to calculate a standard cost for each of them, as at least some firms in the industry have already demonstrated. The term 'standard cost' has here been introduced for the first time. This is not the time or place to discuss the virtues of standard versus historic costs, but the following quotation may serve to emphasize that standard costing should be the basis of any uniform cost system for the steel industry:

> 1. That management, in considering the future and preparing plans, should make the fullest use of budgeting and forecasting based on accounting and costing data.
> 2. That top management should make use of standards of

performance and of accounting control techniques to enable it to decentralize responsibility, and that all standards of performance should be agreed with those who are to work them.[2]

Assuming that standard costs of each product are available for all the main products, the question arises as to how a national standard cost should be compiled. Various methods may be adopted:

(1) An over-all average cost.
(2) An average cost omitting the very low and very high cost producers.
(3) An average of the lower cost producers.
(4) An average of the higher cost producers.

Arguments could be produced in favour of all methods, but it appears to the writer that the answer to the problem lies in the relative efficiency of the industry. A nationalized industry must not be protected against inefficiency and the national cost should not recognize the effect of inefficient plants. It is suggested, therefore, that the national standard cost of each product should be based on the costs of the more efficient (in the sense of lower cost) firms.

There are of course many difficulties. Some steel firms will start with iron ore and work right through to a finished product. Others buy pig iron and scrap and start with steel manufacturing. Further down the line are the firms which buy semi-finished steel as their raw material. Additional complications are raised by the facts that some firms have to use foreign iron ore whereas a few others can use much cheaper home ores, and that iron and steel scrap prices have not been allowed to rise to economic levels.

The industry operates a complicated system of levies and remissions which is intended amongst other things, to spread the consequences of these variations over the whole industry. Whether this is economically sound is debatable, because the firms with natural advantages certainly cannot reap the full benefit from them, and they have to subsidize the plants not so fortunate. These levies and remissions have to be included in costs, so that the true cost of any steel product at any individual plant is virtually unknown.

These complications arose out of war-time difficulties, but if the industry is to serve the nation properly, it does seem that it must get down to the task of ascertaining the real economics; and this question of levies and remissions will probably have to be cleared up before a correct price policy can be formulated.

(ii) *The relative efficiency of the industry.* The mere ascertainment of a

[2] Report of the Management Accounting Team on its visit to the U.S.A. in 1950 – p. 16 – Recommendations.

national product cost and the addition to it of a margin of profit would not necessarily produce an economic price. A grossly inefficient basic industry with profits guaranteed in this way could eventually ruin the national economy. Some means must therefore be found — however vague and inaccurate — of assessing the relative efficiency of an industry with that of its world competitors.

The level of prices in the export markets may not be a true guide — although *at present*, with a world-wide shortage of basic materials, and with few producing countries being unable to consume all their own production, it might be the best guide available.

For some years now great play has been made with the fact that British Iron and Steel prices are generally the lowest in the world. There is no evidence that British plants are on average more efficient than others, and indeed if the rate of expansion of productive capacity is taken as a guide, there are many countries ahead of us. It would seem, therefore, that this pride in low prices for British iron and steel products might be misplaced. Could it not be that home steel prices are too low? The industry itself seems to be divided upon the point.

What is really needed if economic prices are to be arrived at is an economic study of the industry by an independent authority. Further, if a sound policy of maintaining a basic industry at an efficient level is to be formulated, it would appear to be necessary for such a study to be repeated at regular intervals of, say, 10 years.

If as a result of the economic study an industry were proved inefficient, the problem of re-vitalizing it would have to be tackled. Additional capital would be needed, but it would seem undesirable to expect the consumer to provide any great part of it. This of course is a matter on which economists might be expected to advise. If home costs are too high due to inefficiency, then the consumer might reasonably expect that some cognisance is taken of this fact before a profit margin is calculated.

(iii) *The elements in the profit margin.* The problem to be examined in this connection is how to establish and calculate a reasonable or economic profit. Profit might be expected to cover the following:

(1) The service of issued and loan capital.
(2) The replacement of fixed assets.
(3) A margin for expansion, modernization and any increase required in working capital.

Item (1) may be regarded as a *sine qua non*.

The *replacement of fixed assets* is probably acceptable if replacement at original cost is envisaged. At present this is virtually impossible and the question arises: should profits be high enough to cover the replacement of assets at current costs?

On the face of it this seems a reasonable proposition especially to the management of a company. If profits are not high enough to permit plant replacement, then it would seem that capital is gradually being distributed — either to customers or to shareholders. Before any conclusion can be reached on this matter, however, the following questions must be answered:

(*a*) How is replacement at 'current cost' to be calculated? Will the fall in the value of money be permanent at 1952 level, or might it not increase again by, say, 1960?

(*b*) As inflation or deflation vary in intensity, how is the backlog of the replacement provision to be dealt with? In years of gradual inflation an increasing and cumulative provision would have to be met and current profits would have to meet deficiencies of provisions in earlier years. By this means steel prices could reach astronomical levels.

(*c*) Why should the owner of shares in an industrial undertaking be placed in the privileged position of being protected from the fall in the value of money?

(*d*) If it is right for fixed assets to be dealt with in this manner, is it not correct for replacement of liquid capital also to be financed by the customer?

This again is largely a question for economists to settle. Accountants and business men generally are worried by the fact that although profits are rising the liabilities towards the profits are also increasing with even greater speed.

In industries such as we are discussing the problem would appear to be most easily settled by some form of tax *relief* on capital expenditure on plant replacement. The difficulties will arise when it is necessary to decide how much capital has actually gone to replacement and how much to modernization and expansion. Perhaps an arbitrary assessment would suffice so that *some* contribution is made by the community in general to the finance required. It might perhaps be regarded as only fair that the shareholders and consumers should also make some contribution — basic industries being so directly vital to both of them.

The problem of including in the profit margin something to allow for *expansion or modernization of production*, or for *increased working capital* is again a debatable point. It is the modern fashion to regard profit as insufficient unless it gives a surplus (as large as possible) which may be used for 'ploughing back'. Whether it is right that this pure capital increase should be provided by the market seems open to doubt. If it results in *export prices* which are out of proportion with those of other countries then competition will in the ultimate remove the difference: either directly, or indirectly, by providing

an incentive to other countries to set up their own industries. The answer to the problem in the export market, therefore, appears to lie in the actions of other countries, and that in the long-run the market itself will settle the difficulty — probably by refusing to provide the required capital.

It is for economists to debate this matter as far as *home prices* are concerned, and to decide what effect the inclusion of a surplus for expansion of productive capacity in the margin will have upon the national economy in the long-run. The almost irresistible temptation to industrialists is to charge as high a price as the market will stand at all times, so that good times will finance bad, and recourse to the capital market is made as infrequent as possible. This is a policy which is perhaps the fault of the bitter experiences of basic industries between the two wars. Judged solely from an individual management viewpoint it looks reasonable, but prices fixed on this basis are not of necessity economically sound at any particular period. Given free competition, economic forces will no doubt eventually produce economic prices in any industry (as in the export market), but it is often a painful process and in any case, examples of free competition appear to be becoming fewer.

In the heavy steel industry prices have been so controlled that a frequent complaint is made that they are too tight. (The danger in making such general statements lies in the fact that there are so many different steel products — it may be correct for some but wrong for others.) On the other hand, they have, over-all, allowed for substantial sums to be contributed by its customers to the capital development of the industry. In the first 5-year plan which the steel industry published after the last war, it was estimated that the industry itself would from its own resources — i.e., accrued reserves and future surpluses — be able to finance half the cost of the capital expenditure envisaged. This estimate was made much easier of achievement by the introduction of initial allowances (which in principle very strongly resemble hire purchase!) and it may be that in the event much more than half of the cost of the plan came from the market.

The industry has probably been spending at the rate of something like £50Mn per annum, and now that accrued war-time reserves have been exhausted, it is no doubt beginning to find the financing of its second five-year plan impossible without heavy contributions from the capital market — the increases in available surpluses being no doubt offset by the higher costs of capital developments.

The problem of how much of the development cost should be recovered in prices is therefore becoming acute in this industry, and

it will be interesting to see what the official ruling will be. Unfortunately, the decision which is taken is more likely to be influenced by political rather than economic considerations.

If, however, such large sums continue to be recovered directly from the market, for industry as a whole — trying all the time to keep in line with rising capital costs — there would seem to be no end to inflation. It may be an economic heresy to suggest that some limit should be placed on this price component as a first step in a deflationary policy, either by freezing or reducing prices, but it would seem to be as painless a deflationary step as could be devised (assuming that such a policy is a correct one). It might be difficult to apply to industry generally (although not impossible), but for controlled industries all that is necessary is the official will. The writer is not an economist, and the suggestion is made for the experts to discuss.

It is, of course, appreciated that taxation can operate to reduce surpluses, but this method tends to result in increased rather than decreased prices, in a further effort to make the customer contribute still more. It is the direct limitation of surpluses through price control which is advocated.

(iv) *Method of Applying Profit Margins.* Having agreed what the profit margin is to provide in total, it is next necessary to add a fair proportion of the total profit required to each separate product — if each product is to be sold at an economic price. Obviously, an 'economic price' in this sense means one which is economic to the industry and national economy as a whole; prices cannot be fixed so as to be economic to all the individual firms.

The first thought is that the profit margin should be added to cost in the form of a percentage on the basis of the cost of a productive unit — say a ton of steel. Calculating a profit margin on cost has, however, serious drawbacks. A 20 per cent profit margin on cost may easily produce results such as Product 'A' making £5 per ton profit, and Product 'B' £15 per ton profit. The next pitfall is to regard Product 'B' as being more profitable that Product 'A'. If, however, one ton of Product 'B' takes four times as long to produce as Product 'A', then it is better to manufacture Product 'A'. If only two or three products are manufactured in a factory, such a truth might be self-evident. In the steel industry, however, individual products manfactured in any one works are usually so numerous that it is regarded as almost impossible to separate them out individually — and profit per ton (taken over broad groups) is often regarded as the most significant factor.

Perhaps it will be helpful to go back to the real beginnings of

industrial production to get another slant on the matter. If a new company were to consider the erection of a factory it is hardly likely that prices would be primarily fixed on a cost per ton basis, as actual costs will be unknown — only estimates will be available. The first question that will be asked before the capital expenditure is incurred will be — What will be the return on the investment? To answer this question, estimated costs will be calculated for a given level of output, and then, if the existing market controls prices, the return on the investment will be calculated accordingly. If the product were a new one, the entrepreneur would *fix prices which would give him a desired return on the investment.* He would not in the first instance fix a price which would be a given percentage over cost — such a comparison would be a later event. The suggestion is, therefore, that it might be sounder to fix prices on the basis of a relationship between profit and capital employed, rather than on one between cost and profit.

The difference in prices arising from these two methods may be substantial. This may be simply illustrated by taking an example of two similar articles made in the same plant but from different raw materials — the actual cost of conversion (i.e. use of plant and labour) being substantially the same in both cases:

	Product A in Special Steel	*Product B in Mild Steel*
	£	£
Raw material Cost	20	2
Conversion Cost	12	10
Total Cost	32	12
(I) Profit required calculated on a basis of 20 per cent on cost	£6 8s.	£2 8s.
(II) Profit required calculated on a basis of 20 per cent on capital employed, say	£4	£3 15s.

Under (I) the difference between the two product profits is substantial because of the wide variation of raw material costs. Under (II) the profit margin difference is small, because most of the additional cost is that of the higher working capital required to finance stocks. The figures are of course fictitious and the relationships between methods (I) and (II) are therefore arbitrary. On the other hand, the relationships between Products 'A' and 'B' are reasonably accurate for the conditions stated, which are by no means artificial, and variations on them innumerable.

The conclusion, therefore, is that if capital employed is used as a basis of assessing the margin of profit, then the required return on the investment is assured. When cost is used as a basis, the return on the investment may or may not be adequate.

These notes on this aspect of price-fixing are perhaps a digression, and they can only form a brief introduction to the subject. They are sufficient, however, to show that the problem is not a simple one, and the calculation of what has been termed an economic price may eventually depend on this particular point.

Before this suggestion can be adopted it will be necessary to define what is meant by capital employed and how it can be calculated for each individual product. This is probably mostly an accountancy problem, and one so controversial as to need more discussion than the scope of these notes allows — dealing as they do with main principles only. Perhaps it is sufficient to say at this stage that 'capital employed' should include both fixed and working capital and the appropriate rate of absorption calculated for each separately.

SUMMARY

The foregoing perhaps contains too many tentative suggestions. In order that a real basis for discussion may be provided, the following are put forward as recommendations of principles to be adopted for price-fixing in publicly controlled or administered industries:

(1) A National standard cost should be calculated for each individual product.

(2) An economic study of the industry should be carried out so as to ascertain whether the national standard costs are related to a reasonably efficient basis of manufacture.

(3) A gross profit margin (i.e. before deduction of tax) should then be calculated *for each product*, based on a return of 20 per cent on the net capital employed, which should then provide sufficient funds to:

  (*a*) service the capital,

  (*b*) ensure replacement of existing plant at a level of cost considerably higher than that of 1939, but not at the present (probably) peak inflationary cost, and

  (*c*) a small margin for modernization of plant, but not for large extensions of productive capacity.

The calculation of the return of 20 per cent has been based on conditions operating in the heavy steel industry — which is an industry requiring very large investment in fixed assets. For other industries a lower return might be sufficient, but each industry would have to be considered on its merits.

SHEFFIELD

STEEL PRICE POLICY

by ROBERT SHONE

MR. STONES'S article on price policy is certainly stimulating. It provides a convenient starting point from which to comment, not only on certain practical aspects of steel price policy, but also on matters of principle. With much that Mr. Stones says I am in complete agreement; and the fact that some of my comments have a critical flavour should not be allowed to obscure the large area of common ground between us.

Methods of Costing. So far as the machinery of price control is concerned, the first point referred to by Mr. Stones is the costing mechanism. The uniform cost system of the steel industry, devised in 1936, was not made compulsory — fortunately, I think, as many cost developments have taken place since that date. 'Standard costs' and other matters which Mr. Stones details might have been precluded if an attempt had been made to impose a rigid system on all firms. The uniform cost system has, however, been largely adopted and, where not adopted precisely, it has formed a useful guide on which firms no doubt believe they have in a number of respects improved. It has also been made publicly available and widely used in many parts of the World.

The cost system provides the basis on which the forms used for collecting costs for price control purposes — the 'running costs' — have been drawn up. Firms who do not follow the uniform cost system in their own accounts necessarily have to make a number of adjustments to bring them into line for the running costs. The accountants collecting these costs for price fixing purposes issue periodical reports on the reconciliation between firms' own costs and those submitted so that it can be seen that the figures truly represent the industry's costs.

The Averaging of Costs. Mr. Stones draws attention to what he considers two defects in the system. The first is that the returns submitted group together a large number of products of widely varying costs to give an average. Thus, in the case of plates, one cost per ton is submitted for a whole range of sizes from small to large plates; the cost figures — which show in considerable detail the various materials used, pig iron and scrap, labour costs, carriage, etc. — are compared with the final realized price for the month of the firm's total production of these products. It is certainly true that, within the average figures returned, there will have been an appreciable difference in cost between, say, the thinner and thicker plates. The thinner plate

requires more rolling and therefore costs more to produce; it consequently carries a higher price. Mr. Stones apparently thinks that each size should be costed separately. This, however, would involve a great multiplication of the detail of costing, because there are innumerable sizes, shapes and qualities within each steel category. It would indeed make the problem of price control on a cost basis almost completely unmanageable.

Fortunately, it is not necessary to undertake all this work. Price control is made manageable by the controlling body looking regularly at the overall position, and very largely delegating to the trade itself the problem of fixing the relative prices within a product group as between the different sizes and qualities. Providing the general level of price is correct as between producer and consumer, the industry itself can be presumed to be interested in securing a reasonable relationship between the prices of different items, so that a firm producing more of the smaller sizes does not benefit or lose as against a firm producing more of the larger sizes. It is therefore a job for someone much further down the line to bother about whether the 'extras' for this or that item should be increased or reduced. Since the cost data collected cover the total output, including all sizes, the trade is prevented from obtaining higher profits by increasing all the extras. The trade itself must therefore face the question whether, within a fair average return over the whole output, the price of one product is right in relation to another.

It may be appropriate that the controlling authority should from time to time examine the question of extras — if it feels the trade itself is backward in keeping its extras structure (i.e. the relativity of prices as between different sizes) in correct balance. This, however, is a question of going into the matter on a technical basis as a special investigation. It would be most undesirable to be analysing month by month or quarter by quarter the great mass of detail involved in this question.

Although Mr. Stones argues that the extras are in many cases 'only charged at the pre-war price', this is not generally the case. Within the lighter section group, for example, extras for smaller sizes are in many cases now almost double pre-war. The extra for the small orders has been increased from 5s. to 25s. a ton. The zone extras in the heavy steel group for delivery to the London area have increased from 2s. 6d. before the war to 10s. at present. These are only three out of many examples. There has been a constant adjustment of extras and an encouragement to the makers to be examining the matter and to be working on the problem of keeping the relativity of prices correct. Mr. Stones writes as a steel-maker in this

matter, and on him and his colleagues rests the responsibility of getting the relationship within product groups correct. This is not a burden which would be expected to fall on the price controlling authority.

Indeed it is precisely because of this broad approach that the steel costing and price system is so much to be preferred to more detailed price control arrangements, such, for example, as individual contract costing. When the controlling body has to cost a particular contract or item, out of a large total activity of a firm, the allocation of charges and overheads is so arbitrary that it quite swamps in importance any nice consideration of a fair profit margin. On the other hand, by costing the whole output of main sections of a firm's business at one time — and reconciling the total of the main sections with the annual accounts — the doubts and inaccuracies of individual contract costing are avoided. Further, when the price fixed is not related to the costs of the individual firm, but is the same for all producers, it provides the incentive of increased earnings if costs are reduced and the penalty of losses if one firm does not progress as fast as others.

The Production Period and Costing. Mr. Stones's second detailed criticism is that the costs for a given month are related to deliveries during the same period. This, of course, tends to produce inaccuracies in any one month, because a particular firm's deliveries may be, say, of the lighter sizes, which command a higher price, whereas its production during the month — a good deal of which will be delivered after the end of the month — may have been largely weighted with the heavier, and therefore cheaper, products. In this event, the apparent profit during the month would be high, whereas the following month the reverse might be experienced. This problem is particularly acute when the production cycle is long, though in the heavier steel products about which Mr. Stones is particularly writing, it is relatively short. Nevertheless, this factor may well distort one month's cost, and it is for this reason that the figures are normally looked at quarter by quarter, rather than month by month. For the purpose of price fixing in relation to the whole industry, however, the distortion, even over a short period, must obviously be less significant than it is in the case of any one firm.

The alternative of comparing the prices of the products delivered during a month, not with costs during that month, but with those obtaining when the products were made — some of the products having been made, say, two, four or eight weeks previously — is much more complex. It can be attempted, but on balance the argument has so far been considered to be strongly in favour of the simpler

approach of showing the actual cost during the month and the actual realized prices during the month.

Individual Product Prices. Mr. Stones expresses the opinion that 'it does not seem unreasonable to suggest that an economic price should be fixed for every product from a nationalized industry'. It is certainly not unreasonable, and it is no less important if the industry is not nationalized that the prices should be economic for each product; and this is in fact the objective of the policy adopted on steel prices. So far as the detail is concerned — that is to say, one product *within* a group as against another — if there is fault here it lies with the industry itself, and with particular branches of the industry, and, as mentioned previously, could readily be remedied by them. There has been no objection in principle from the price controlling authority that would prevent readjustments of this sort.

Mr. Stones may, however, be referring to a lack of balance between one major product group and another. This, of course, would be quite apparent from the cost returns. If it arises, and shows signs of persisting over any serious length of time, it should be corrected. Care is needed, however, when considering this matter, as products which may not pay one firm may pay another quite well: and it has never been the object of the policy adopted in steel pricing to fix prices on a level so that every producer at however high a cost can secure a profit.

Nevertheless it is true to say that there has been a fairly persistent tendency for the margin on semi-finished steel particularly — but also on heavy steel generally — to be lower than that earned on later finishing operations. This may in part have been due to political considerations, which tend to make it difficult to increase the prices of controlled products in periods of rising costs.

More highly finished products have not generally been subject to the same rather special degree of public watchfulness so that their margin has generally been good, at least at times when output has been high. Public watchfulness can be exercised more precisely in the case of the primary products we have been discussing; it has perhaps understandably been more concerned with the danger of prices being too high, and is only slowly coming to realize that there may be equal dangers in their being too low. The following table shows the effect of this policy in keeping the primary steel products at well below the world price level.

It may also be that the problem of the low earnings on semi-finished steel is tied up with the question of the delivered price. In spite of what some commentators — although not Mr. Stones — have said, it is the general policy in the industry to charge higher

INTERNATIONAL HOME TRADE PRICE COMPARISON, SEPTEMBER, 1952
Per ton of 2240 lb.

Product	*Size*	*Quantity of a size*	*Order*	*U.K.*	*U.S.A.*	*France*	*Germany*	*Belgium*
		Tons	Tons	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Angles	5" × 5" × ½"	5	20	27 19 6	36 16 0	36 0 5	39 7 0	31 9 11
Joists	12" web	5	20	28 0 6	36 8 0	33 18 11	37 5 6	31 12 10
Plates	20' × 60" × ¼"	5	20	31 16 6	37 4 0	41 8 2	44 15 0	37 8 3
Strip	3" × $\frac{5}{16}$"	10	20	32 14 6	39 16 0	34 6 5	45 4 6	35 11 2
Rails	90 lb/yd	500	500	28 12 6	32 0 0	36 15 11	35 13 3	38 2 0
Sheets	6' × 3' × 20G	25	25	40 2 6	42 12 0	49 10 8	51 17 6	52 5 0
Tinplate (per basis box)	20" × 14", 108 lbs.	50	50	2 15 10½	3 2 10	4 11 5 (a)	4 15 4	(b)

Note: The general basis of comparison is Tested Steel, delivered to consumers' station (Rails and tinplate—F.O.T. makers' works). The prices are for Open Hearth quality except in the case of France and Belgium where they are for basic Bessemer quality. The extra for Open Hearth quality is approximately £3 per ton in France and £10 per ton in Belgium.
(a) Delivered consumers' station.
(b) No comparable price available. Production is relatively small.

prices for delivery to consuming points at a distance from the steelworks. Thus, in the case of both scrap and pig iron, the price is higher at the centres drawing in supplies, and lower in the areas with a surplus. Similarly, in the case of heavy and light sections and many other finished steel products, the price at the steel-making centres is lower than the price delivered to London and the South of England and other zones at a distance from the steelworks. In the case of billets, however, a uniform price has prevailed over the whole country. This means that the transfer price when the billets are used for finishing operations in integrated works is the same as that at which they are delivered into 'importing' areas, such as the Midlands. The consequence naturally is that outside deliveries over any considerable distance are likely to be uneconomic, and this may account for the fact that is so widely recognized in the trade that delivery of billets to independent re-rolling works is generally unprofitable.

It would certainly seem desirable in this case to change the policy to bring it more closely into line with the general practice of reflecting delivery charges that prevails in raw materials and steel generally.

Artificial Elements in Costs. A more fundamental question, touched on by Mr. Stones, is whether the system of levies in the industry disguises the true costs of production. He suggests that, because of these arrangements, the true cost of a steel product at any individual plant 'is virtually unknown'. This would seem to be taking an unnecessarily gloomy view about the effects of these arrangements. If they were to distort costs to the extent he suggests, they would indeed be subject to the gravest criticism. About two-thirds of the levy burden, amounting to about £3 per ton on ingots, consists of a flat levy per ton of ingots and per ton of semi-finished steel, designed to finance the excess cost of the big imports of steel being brought in at the present time — or to a lesser extent of imports of scrap and pig iron in place of steel, when these can be obtained. These levies are

at a uniform rate on all ingot production and a uniform rate on all semi-finished steel production and are reflected in a corresponding addition to the price of the products made. This arrangement should lead to little distortion in considering the price of any product group, since the addition of the levy to cost and to the realized price is the same. The arrangement is an almost inevitable consequence of the policy of keeping British home trade prices well below the world level. So long as British prices are kept low, the only alternative would be to sell the imported steel at prices far above the British price. This would be an exceedingly difficult policy to pursue when steel is subject to allocation, because some users would obtain low-cost British steel and others, arbitrarily, would have to pay the higher price for imported steel. The figure is high at the moment owing to the current large import programme, but should not, of course, remain at this level for long.

However, I do not think Mr. Stones is criticizing this particular feature of policy, but rather making the point that on raw materials the levy arrangements distort the home production cost structure; in particular that artificial relationships are established between the cost of home and imported ore and between the cost of using pig iron and scrap.

Home and Imported Ore. To take the iron ore position first. During the war there was an extreme inflation of shipping costs, so that the c.i.f. price of imported ore rose to quite exceptional heights. At their peak, freight rates were some six times the pre-war level. This full cost was not passed on to the users. After the war, a policy was adopted of gradually increasing the price of imported ore and at the same time of working towards a reduced level of freights. As a result, the cost of imported ore had fallen by 1950 and the price charged to the makers had risen, so that they were in balance. Thus no subsidy, levy or other arrangement was involved on imported iron ore as compared with home iron ore. Imported ore prices were then some 150 per cent above the pre-war level.

In 1951 and 1952, however, purchase prices for imported iron ore were very much higher; in fact the delivered cost of iron ore this year is approximately double the 1950 cost. Since 1950, however, the increase has not been passed on to the user of imported ore, whereas the user of home ore has been subject to increased cost as wages and other costs of ore getting have risen. The loss involved in selling the imported ore to the pig iron producers at the 1950 prices accounts for nearly £2 a ton of the ingot levy, or almost all the balance of the levy. This ore policy can rightly be questioned. It might be justifiable if the increase in foreign ore prices was likely to

be purely temporary, so that after a short period they could be expected to revert to the 1950 level. However, there seems little chance of this happening, partly because devaluation has in any case changed the position since 1950, and partly because the developments designed to increase the supply of imported ore are leading further and further afield, as is seen in the American expansion in Labrador and Venezuela, and the British developments in West Africa.

While, however, there is every likelihood that the c.i.f. price of foreign ore will, for a considerable period at any rate, be above the 1950 level, there is reason to expect that it will not stay at the present high level. Indeed, the fall in freight rates has already brought the c.i.f. cost down to about double the 1950 figure as compared with a level about 120 per cent above the 1950 figure at the beginning of this year. The Federation have been anxious for a more realistic price to be charged for imported ore, so that the loss involved could again be eliminated by the policy successfully adopted up to 1950—that of trying to get the buying price down and adjusting the selling-price to the user upwards. The problem has not, however, been seen by others as one of urgency; discussions which have been proceeding since February of this year had not, six months later, led to any conclusion, in spite of the strong view of the Federation supported by the firms in the industry, whether adversely affected or not, that much greater realism could and should be secured. Notwithstanding this delay, it is to be hoped that the unrealistic element in the imported ore price arrangements will soon be reduced and later eliminated entirely, through falling purchase prices, as in 1950.[1]

Scrap and Pig Iron. The other element that presents features of artificiality is the disparity between scrap and pig iron prices. This disparity has arisen from the policy view of the Government, the industry, and the scrap trade, that to maintain stable prices of scrap over long periods ensures the regular supply of the maximum quantities. In a period of general inflation, this policy is bound to leave the scrap price behind other prices and thus to keep it relatively low; at the present time the stabilized scrap price is about £6 per ton — which, though double the pre-war price, is well below the present pig iron price of about £12 10s. a ton.

It is fully recognized that distortion in the industry can arise if the cost of scrap is kept artificially low in relation to pig iron. A close examination of the relativity of scrap and pig iron prices over a period of years, and in various countries when free market conditions

[1] The new imported ore price arrangements in fact came into effect on October 13th, 1952, as this issue was going to press.

obtained in both, shows that scrap is normally somewhat cheaper than pig iron, being, on the average, about 75-80 per cent of the pig iron price. It is to secure this position in Britain that a levy has been charged on scrap and a remission given on pig iron used for steel making. These together are designed to have the effect of bringing the cost of scrap to the steelmaker up to the relationship to pig iron indicated.

Thus, the artificiality in the case of scrap does not lie in distorting costs to the individual firm. It lies in paying the supplier of scrap a price different from what it would fetch in a competitive market. There is room for a good deal of discussion on this point. On the one hand it is felt, as already stated, that stability of scrap prices over a period permits a steadier flow than would be likely in a speculative market with prices rising and falling. It is feared that the latter policy would result, in times of shortage, in a tendency to hold back scrap just when it is most needed, in the hope of a price rise.

On the other hand, it could be argued that the supply of scrap might be increased by fluctuating prices, even though the general trade and Government opinion has taken a different view. The degree of scrap collection achieved in Britain is at least as high as anywhere else in the world, and it has not seemed likely that there would be any advantage from a policy of fluctuating purchase price for scrap. Whatever may be the merits of the alternative policies — and Mr. Stones expresses no opinion on them — the levy on scrap, and the pig iron remission, is designed to correct an artificiality — not to create one. It ensures that from the point of view of the steelmaker's costs, scrap is related to pig iron on the sort of basis that would prevail over a period in the case of competitive purchases.

To sum up: it is entirely accepted by the industry that costs should be realistic. The delay in adjusting imported ore prices is a departure from previous policy and should soon be overcome; the levy on scrap is necessary to ensure that the cost of scrap to the steelmaker is realistic, despite the fact that the buying price of scrap has been stabilized at a relatively low level.

Independent Review. Mr. Stones presses for a periodic review of the economics of the industry by an independent authority every 10 years or so. The Iron and Steel Board proposed in the Government's White Paper will, in fact, be specifically charged with price matters. Since it will have within its purview the whole output of the industry — and not merely some sectors — and will include representatives of consumers and producers, it should, with an

adequate staff, be admirably suited to reaching a fair conclusion and publicly stating the principles on which the price policy of the industry is operated.

The Basis of Costing. Mr. Stones then proceeds to discuss some of the elements that might be included in cost. The first point is whether efficient firms only should be taken, or whether prices should be fixed on some other basis, perhaps even on the basis of the highest cost producer needed to secure the supply. This latter solution would seem theoretically to be the closest to the principle enunciated in modern marginal analysis under which the price would be just sufficient to meet prime costs of the marginal producer (or of the marginal output of all producers). Equally, the price might be fixed on the average cost of all producers or on the cost of the 'most efficient' producer. If 'efficiency' needs defining more closely, then it might be fixed, in the case of an expanding industry, at the price at which new plant can operate and secure a reasonable return on current capital costs.

It would take too long to go into all these various possibilities here, but it should not be assumed that to base prices on the cost at a new efficient plant would necessarily give a lower price than basing on an average cost or on the highest cost producer needed to secure the level of output required. The result would in fact vary from section to section in the trade.

The important thing to bear in mind is that whichever selection of firms is taken for operating costs implies a different treatment of the capital charge element. If the marginal firm is chosen, then the capital charge would be expected to be zero. If the average of cost is taken, then the charge would be that appropriate to a plant written down as though it were at least, say, half way through its life. In fact, the Iron and Steel Board, who completed the last major review of price policy early in 1949, followed much this approach. The effect was to allow an amount for depreciation equal to about 35 per cent of the depreciation appropriate to a new plant. If, however, a policy is followed of fixing prices on the best costs that can be achieved at fully up-to-date plant, then clearly the capital charges included should be appropriate to a new plant.

Replacement Cost. For many products a policy of relating prices to current operating and capital costs at a modern plant would give a higher figure than today's actual prices. This raises the whole question of pricing in relation to replacement costs. Mr. Stones approaches this question but appears to shy away from it. I should have thought, as a matter of principle, that it was imperative that prices should — certainly in an expanding industry — be fixed in

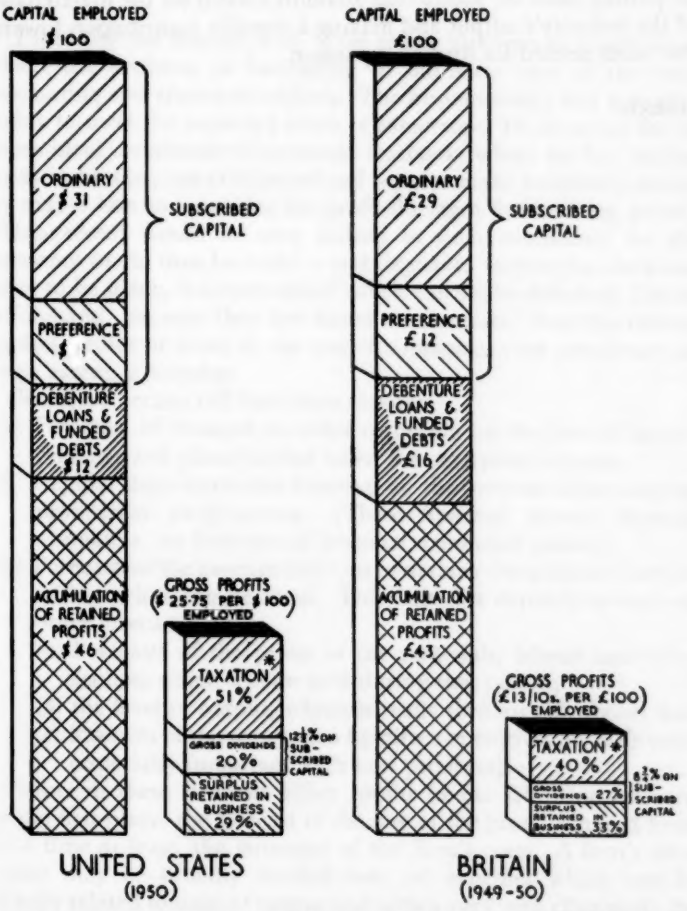
relation to replacement cost. Unless this is done it will not be possible to secure the necessary expansion of capacity; nor will the funds set aside by the industry in any year for depreciation be sufficient to make good the wearing down of plant or, in other words, to provide the sums needed to be spent in the same year on the new plant needed merely to keep the capital equipment intact.

There would seem to be no doubt that the correct economic approach is to calculate depreciation on a replacement cost basis. I should myself be prepared to argue that it is also necessary to compute the interest charge on replacement cost. In periods of falling prices, industry cannot be expected to earn a margin in excess of that necessary to give a fair return on new capital at the low capital costs which would then prevail. Under competitive conditions it is, in fact, necessary, when prices are low, to accept earnings related to current low replacement costs. Similarly, in periods of rising prices, an interest charge must have regard to the capital cost of new plant, if new plant is required in an industry.

Of course, it follows that replacement cost should also be adopted for taxation purposes. It has been argued that this would represent a great burden on the national finances. Since, however, one of the major objectives of budgetary policy, at least in times of inflation, is to provide savings which are not being made by the general public, the allowance of proper sums for depreciation would merely represent a reduction of tax collected on savings — and the leaving of such savings in the place where they should properly accrue.

The tightness with which British steel prices have been controlled — and in this I am in full agreement with Mr. Stones — is seen in the diagram (taken from the recent Iron and Steel Productivity Team's Report) which shows earnings as a percentage of turnover in the United States and Britain. It will be seen that the amount distributed in dividends is less in Britain than in America and the amount available for replacement or expansion of plant is also only about half as much per ton of output in Britain. Yet the capital cost of a new plant, whether for replacement or extension, is approximately the same in both America and Britain. The lower amount which can be set aside out of earnings in this country for capital expenditure is also reflected in the international price comparison quoted earlier. It must be a very questionable policy to keep steel prices down below the world level, particularly in an industry such as steel, when heavy sums are inevitably needed for the maintenance and expansion of plant. It is even doubtful whether it is really in the interests of the steel-using industries to be receiving supplies at well below the world level. Sooner or later costs and prices in the various countries

PROPORTIONATE DISTRIBUTION OF CAPITAL AND PROFITS



* Tax liability: In normal British practice this figure includes taxes on dividends (deducted at source). The American figures do not, however, include such a tax, and the British figures have therefore been adjusted to a comparable basis by using gross dividends and making a corresponding adjustment on tax liability.

are likely to move closer together and it cannot be expected that there will be a substantial permanent advantage in steel prices in favour of users in this country. Now would seem to be the time to be putting aside the substantial amounts needed for the maintenance of the industry's output and making a sizeable contribution towards the funds needed for further expansion.

LONDON

THE PROBLEM OF BUSINESS FORECASTING

by FRANK A. FRIDAY

1. Forecasting and Business Risk. This article attempts to clarify ideas about the problem of forecasting in business — one of the most fascinating and elusive of subjects. The businessman's task is to plan today to meet the expected needs of tomorrow. He does not live in those ideal conditions of economic textbooks where he has, tucked away in his files, sets of demand and supply curves accurately drawn to enable him to maximize his profit during a forthcoming period. Management would be easy indeed in such conditions, for the economy would then be static — and stagnant. In practice, decisions have to be made, the outcome of which cannot be definitely known beforehand, because they are based on forecasts. For this reason, trading profits or losses at the end of a financial year are always, to some extent, a surprise.

Business forecasts fall into three classes:

(i) Forecasts of demand in order to decide on the size of factory premises and plant needed when the enterprise is begun.

(ii) Regular short-term sales forecasts for the purpose of drawing up production programmes. (These forecasts always depend, ultimately, on forecasts of personal, consumer needs.)

(iii) Forecasts of the average unit cost of making the goods so that the selling prices can be fixed. This unit cost depends in turn on other forecasts:

  (*a*) Forecasts of the prices of the materials, labour and other services which will be used during that period;

  (*b*) the level of output, which is really forecast (ii) above; and

  (*c*) forecasts of the time taken by direct operatives on their work (especially important with new products).

Errors in these forecasts affect profits in the following manner. In the first place, the forecast of the size of the plant required fixes, for a time at least, the structure of the firm's costs. A firm's total outlay may be broadly divided into (*a*) expenses which can be directly related to units of output and which vary with changes in the volume of output—the direct or prime costs of production; and (*b*) costs which cannot be so related but are in the nature of 'time' expenses applicable to the firm as a whole, and which remain fairly constant over a given period of time whatever the level of output — the indirect, or overhead, costs. The average indirect cost per unit and, therefore, the average total cost of an article, increases as the volume of output falls below the output which is possible with the

factory's maximum complement of direct operatives working their normal weekly hours. If the factory has been established on an over-optimistic forecast, the firm will suffer from a high cost structure and there will be little that can be done about it except increase the firm's range of products, perhaps by entering other trades. Even so, the average unit cost of making a large number of different kinds of products will tend to be higher than that of making the one kind of product for which the factory was designed. Leaving aside the question of the effect of differences in the sizes of firms on their full capacity costs per unit of output, variations in their forecasting errors are equivalent to variations in their costs. Uncertainty is a business cost.

Because of its fixed cost structure, a firm has good reason for trying to sell all that the factory can produce; excessive caution may keep stocks low but this will increase costs. On the other hand, the loss resulting from an over-optimistic forecast of sales will first show in an unexpected rise in stocks and a fall in cash resources — a reduction in liquidity which, if the forecasting error is large, may drive the business into its bank for a temporary increase in capital. Some downward adjustment in the factory schedule may be possible, but work-in-progress will have to be completed and there will be an accumulation of materials and components as well as stocks of finished goods to be cleared. What has been produced can, of course, always be sold — at lower prices. Just how low will depend on how bad the forecast has been and on the kind of product. A manufacturer of consumer goods who is responsible for fixing the retail prices of his products will also have to credit his distributors with the difference between the new prices to them and the prices they paid for the stocks they hold — stocks which will also be abnormally high. Goods subject to fashions or to technical change may ultimately be 'jobbed-off' at quite ridiculous prices.

Normally the errors in estimating the cost of production should not be great. Much depends on circumstances. In a monetary inflation, price rises may well precede cost increases generally. But in the capital goods industries, for instance, the pressure of a monetary inflation may take the form of a growing order book. The rises of wages and other prices which occur will then come as an upward pressure on prices from rising costs, and errors in forecasting those rises will cut into expected profits. Similarly, where costs are increasing for external reasons — e.g. increases in import prices — rising costs will push the selling prices upwards; but for mass-produced goods, especially those sold at retail prices determined by the manufacturer, rapid changes in price are not always easy. In deflationary

conditions, with unemployment rising and demand falling, the downward movement of costs will, for most trades, be preceded by some downward movement of prices.

The dependence of business decisions on forecasts is the essence of business risk. Errors cost money; they are also one of the causes of bankruptcy. The value of accurate forecasting in business can hardly be over-estimated. That complete accuracy is an unattainable ideal needs no emphasis, but a consideration of the conditions necessary for obtaining complete accuracy will, nevertheless, provide a useful starting point in this study of forecasting methods. We shall then be able to assess the reasons why, in practice, forecasting falls so often below perfection.

2. *The Nature of the Forecasting Problem.* There are two sets of conditions which must be satisfied before a forecast can be completely accurate. These are:

(1) The event to be forecast must occur (or its value fluctuate) with such regularity that, whether or not we understand the reasons, its occurrence or value can be predicted by projecting the pattern into the future. The best examples of this are to be found in astronomy, where the occurrence of an eclipse can be forecast to within a few seconds of its occurrence.

(2) If there is no such regular rhythm, we must know (i) all the factors causing the occurrence or changes in the value of the event and (ii) the exact relationship between changes in this event or its values, and the occurrence or changes in the value of the causal factors. In order to use this knowledge, we must also be able either (*a*) to control or (*b*) to forecast the occurrence or values of the causal factors. Ability to make forecasts about the causal factors requires, in turn, satisfaction of the first set of conditions (possession of a regular pattern of behaviour) or the second set of conditions (an exact relationship between the causes and their causal factors together with either control over those factors or accurate forecasts about them).

Control over causal factors implies that we have control over their effects, so a forecast is not really necessary at all. If it is possible to make something happen at will, we have no need to forecast how it will happen and when it will happen. (A forecast can, of course, be based on information collected from those who have control; thus, although the Government are not responsible for private investment decisions, they can collect statistics about projected investment programmes from those who do make the decisions.) The acceptance and use of patterns of behaviour on the other hand, implies that we

accept the forecast as we find it, like accepting a rainy day; and merely make arrangements for protective or evasive action. This was largely the attitude towards business forecasting before the war.

The reason why so many Governments have now accepted the responsibility for maintaining in their countries a high level of employment is that they have been persuaded that enough is known about the trade cycle for them to be able to design policies which will keep the economy on an even keel. This means either: (i) that the Government consider they have control over all, or the main, causal factors, or (ii) that their knowledge about the causes of changes enables them to forecast the behaviour of the causes over which they have no (or very little) control and take compensatory action by operating on factors over which they have some control. As a forecasting problem this requires discovery of a stable rhythm of behaviour in the 'first' causes and of a precise connection between the occurrence of or changes in those 'first' causes and their effects. In these circumstances, the business forecaster is entitled to assume that those who can control certain events will, in fact, control those events. Business forecasts must be made, first in the light of existing government policy, and then in the expectation that this policy will be adapted in order to deal with undesirable forecast trends. On the assumption that accuracy in forecasts is possible, there should be no difference between the forecasts of economists inside and those outside the Government.

In business, the forecasts required concern the behaviour of certain parts of the economy and of one part (the firm) in particular. To make these forecasts about products we ought, first, to forecast general economic conditions. This general picture of things to come provides the basis for estimating cost changes as well as for predicting the demand for particular products.

3. Forecasting General Conditions. If we believe that some degree of control is possible over the level of employment and therefore over total incomes, we need not spend any time considering past fluctuations in order to discover a regular cyclical pattern: the cycles of the past should not recur. In fact, as statistical research has shown, fluctuations in trade conditions never followed an exactly regular pattern, so forecasting by projection of statistical series forward was never satisfactory. The problem can, therefore, be discussed in terms of our present knowledge of the causes of trade fluctuations.

Economic activity is essentially a flow of goods and services in exchange for money payments. Changes in this circular flow occur when the level of expenditure changes (this is usually associated with

a change in the pattern of expenditure). This change in expenditure will not be matched immediately by a corresponding change in output. The first impact will be on the stocks of the goods affected by the change, the rise or fall in these stocks being equal to the fall or rise in the expenditure on those goods. To the business man, this change in stocks will mean a change in cash balances; a rise in stocks may indeed mean new borrowing to meet the need for more working capital. Business men will react to this change in stocks and this will itself bring a further change in the level of business activity. The important question is how far the stock changes have resulted from errors in forecasting general trends and how far from errors in forecasting the demand for their own firms' products. A shift in demand from one product to another, for example, means that the increased stocks of the one product are largely offset by decreased stocks of the other. It does not follow that the business man whose share of the market has fallen will lower his next production programme; he may well try to recapture his share. If he fails then his output will, of course, have to be adjusted downwards and he will face seriously high stocks. On the other hand, if the change in demand appears to be a general experience, production programmes will have to be adjusted not only to meet the new level of demand but to allow for sales out of excess stocks or for additions to depleted stocks. For the manufacturer of consumer goods this involves adjustment of his expected sales to take account of stocks held by wholesalers and retailers also. He has to forecast likely consumer purchases and modify these by forecasts of many stock variations in addition to his own.

This change in output causes further changes. When the rate of output is reduced the people whose incomes are lowered or who are thrown out of work will, in turn, lower incomes to the extent that their spending is reduced. Conversely, when output is raised the increase in incomes will give rise to new spending and to further increases in incomes and employment. This cumulative, multiplier, effect will continue until the level and pattern of demand equals the level and pattern of output, when there will also be an equality of savings decisions with investment decisions, temporary differences showing all the time in stock adjustments.

The impetus of these changes in expenditure comes broadly in two ways: (1) There may be a rise or fall in the level of expenditure financed by borrowing or by using past savings. Expenditure on new buildings and plant, the accumulation of initial stocks in a new or expanding business, has to be made before any income is received from sales. These investment decisions are quite separate from savings decisions. (2) There may be a rise or fall in the proportion of incomes,

both business and personal, which is saved. It is often assumed that savings are related in a stable manner to incomes. If they are, the relationship is certainly a very complex one. Personal savings are now a negligible part of total savings and discovery of their relationship to personal disposable incomes is not particularly useful. A more important source of private savings is in the depreciation reserves and undistributed profits of business houses. Thus, the relationship between private savings and incomes depends not merely on personal savings habits but also on the practice of businessmen with respect to depreciation and undistributed profits.

The forecaster has, therefore, to concentrate on finding out the expected level of spending out of borrowed money (virtually investment expenditure) and the expected level of savings. There are, however, complications arising from public authority expenditure and our foreign trading.

Broadly, there are three kinds of public authority expenditure: (i) payments to employees, (ii) purchase of goods and services from the private sector, and (iii) payments of pensions and interest on loans. The first two clearly give rise directly to employment; the third may or may not according to how the recipients dispose of the money. The precise effect of changes in public authority expenditure on the level of incomes depends also on how it is financed. Even if the money required all comes from taxation, we must know the extent to which those taxes have cut into personal and business spending or into savings; the former represents a shift of resources, whilst the latter represents a fall in the savings proportion so that employment and incomes will be raised to produce total savings equal to capital expenditure. It is impossible to estimate with any accuracy the effect of substantial changes in taxation. A change in public authority expenditure financed out of loans, has, of course, exactly the same multiplier effect as investment expenditure.

The forecaster has here some very intractable material. Moreover, in recent years the Government have themselves forced savings by collecting a revenue in excess of their expenditure needs. The probability is high that some part of the revenue going into these public savings was cut from private spending and to that extent total savings must have been higher than they otherwise would have been. The *national* savings proportion has increased, but not the voluntary savings made by persons and businesses. The Government can exercise some control over the savings proportion in this way, but the control is very rough because the knowledge on which it is based is so uncertain.

An important influence on the level of activity arises also from changes in exports and in imports. A fall in the demand for our

exports clearly reduces output, and therefore incomes, with the same multiplier effect as a fall in capital expenditure inside the country. There is, however, a difference. The multiplier pulls down incomes until savings have been reduced by the same amount as the fall in exports. As exports fall, (assuming, for the present, no change in imports) the deficit on the balance of payments rises (which represents a borrowing of overseas funds) or any surplus is reduced (which releases internal savings to the same extent, so leaving total savings sufficient to finance capital expenditure). The multiplier must, however, be derived from the proportion of savings in national incomes, excluding the savings of overseas persons reflected in the balance of payments deficit.

When the national income falls, imports tend to fall also. There is a definite relationship between the two. A fall in imports does not affect incomes received in the U.K.; it merely reduces the quantity of goods available. As a result, there must be either an increase in savings or an increase in spending on home produced instead of imported goods. To the extent that the latter happens there will be a multiplier effect raising incomes until savings are increased by the amount of the fall in imports.

The problem of forecasting economic conditions therefore involves the following knowledge:

(*a*) the expected changes in —
  (i) expenditure on fixed and working capital;
  (ii) exports;
  (iii) imports;
  (iv) public authority expenditure;

(*b*) the relationship between changes in —
  (i) personal savings and personal incomes;
  (ii) business savings and profits;

(*c*) the effect of taxation changes on savings.

An understanding of the factors responsible for changes in economic conditions does not, by itself, make forecasting accurate. Knowledge of the past may give us some control over the future course of events, but it does not necessarily give a clear picture of that future. A knowledge of causal relationships merely enables us to move back to antecedent events which may be easier to forecast than the events which they influence; but, for this to be useful, those factors, as we saw in section two, must behave with a regularity which justifies extrapolation. Alternatively, the control being exercised must be readily ascertainable.

In the list above there are four important determinants of the level of business activity; investment expenditure, exports, imports, and

public authority expenditure. These items are essentially aggregates which summarize the behaviour of groups of persons behaving independently of one another although each must, to some extent, be influenced by the group behaviour.

Over public authority expenditure a large measure of central control can be exercised, although even here, notably in the social services, the estimate of future expenditure is dependent on other forecasts. Government imports are, of course, under central control; private imports can be prevented by licensing from rising, but that is about all. Over private investment and exports central control is negligible (some things can be prevented from happening) and there are no regular past patterns which can be projected into the future. An inquiry can be made to those responsible for capital investment decisions about their plans but this has not so far been attempted in this country. Yet if we cannot get reliable forecasts of these basic variables, a detailed statistical study of the relationship between savings and incomes seems hardly to be worth the trouble. And, if there is, in fact, no clear relationship between savings and incomes, savings cannot be accurately forecast, and knowledge of the future course of these four determinants will be of little use.

The problem of forecasting is still further bedevilled by the need to estimate future price changes. All the aggregates which have been discussed above are measured in terms of money and they vary in consequence with variations in prices. We need not concern ourselves with the statistical problem of constructing index numbers to measure price changes; the movements of price indices in the past have not provided a stable pattern of behaviour on which to base predictions. There are five sets of influences on prices:

(1) Technical progress. This progress results in a reduction of unit costs (excluding profits), causing lower prices or higher incomes, or, perhaps more probably, a combination of both. No steady rate of increase in productivity per head has been discovered (the measurement of changes in productivity is alone a most difficult problem) and the errors in forecasts of the annual increase have, in the post-war period, been very large.

(2) Changes in the prices of imports. These depend, in turn, on so many factors, political as well as economic, that prediction can never be based on a past pattern of experience (and any prediction may, of course, be upset by devaluation or revaluation of the currency). Forecasts are possible only from a rough assessment of world trends.

(3) Changes in the general level of activity. These changes affect prices firstly through profits, especially with price reductions. Inability to foresee changes in activity is the cause of unplanned,

unintended, stock changes; price reductions follow from such stock rises. To some extent, price increases follow stock falls (although this is not always so; much depends on the policy and structure of the industry).

(4) Wage and salary rate changes. These depend both on the general level of activity and on the organization and bargaining strength of groups of employees. Prediction can only be qualitative; it cannot be based on any precise statistical patterns.

(5) Errors in business forecasts. A business house has to predict not merely the general level of economic conditions at home and abroad, but also its own particular receipts and outlays. Without any changes in general economic activity, errors in a firm's estimate of consumers' likely needs and purchases will produce unwanted stocks which may have to be 'jobbed off'. It is difficult to see how such forecasting errors could be forecast!

The requirements for accurate forecasting can very rarely, it would seem, be fulfilled. In economic affairs the difficulty lies in the dependence of one forecast on other forecasts. A study of the underlying factors merely changes the items to be forecast; it does not provide a solution to the problem of forecasting. The value of such analysis is in the guidance it gives in policy formation. Undoubtedly, a knowledge of the relative importance of the factors responsible for changes in the national income provides a sound basis for discussions about the appropriate course of action for reversing undesirable developments. Opinion is not always unanimous about the policy to be adopted and with some parts of economic analysis still incomplete this is not surprising. Much difficulty has also arisen from an inability to see the future with precision, although precision has often been assumed in, for example, the formulation of an annual government budget designed to plug an inflationary gap. The important question — important both for the Government and for businessmen — is: Can undesirable trends really be dealt with ahead on the basis of forecasts? If forecasts are so difficult that they must always be subject to very large margins of error, governments may be formulating inadequate or wrong policies. It might well be more satisfactory to formulate policies which can be adopted quickly when the undesired trends are just beginning. Forecasts can, of course, never be dispensed with; but the emphasis should perhaps be on broad trends rather than exact forecasts; on qualitative rather than quantitative prognostication.

A forecast, it must be remembered, takes time to prepare; so do past statistics. The detailed estimates of the national income are usually published many months after the end of the period to which

they relate. We never know the present but only the past. A forecast begun at the beginning of the period of the forecast has to be based on information about the national income which is at least a year out of date, supplemented by other, less comprehensive but more up-to-date economic series. If, on the other hand, the forecast is delayed until detailed information is available, much of the period to be covered by the forecast will already have passed before the forecast is even started. In the meantime, certain undesirable trends may already have begun. In business, delay is impracticable. An order has to be placed on the factory before the period covered by the forecast begins.

How far the business forecaster is justified in assuming that, as employment and incomes fluctuate, appropriate action by the Government will be taken is a moot point. There should not be, in the future, general fluctuations of the same magnitude as in the past. For firms having large overseas markets, this involves a trust in the ability of overseas governments to iron out fluctuations in incomes which, certainly in the primary producing countries, may be quite unjustified. Ultimately, perhaps, the success in achieving world economic stability in employment will rest on the extent to which a successful employment policy is adopted in the U.S.A.

4. Forecasting the Demand for Products. The forecasting problem facing an individual firm, as explained in the first section, is to make so good an estimate of future demand and of future costs that profits can be estimated with some certainty of achieving them. We have seen that forecasts of general economic conditions and of price movements can only be made very roughly. Whether good forecasts of business demand can be made must depend on how far they have to be based on forecasts of general economic conditions and how far they can be based on extrapolation of other patterns. Let us look at the problem in the light of the requirements for accurate forecasting discussed in the second section. There are four ways in which these requirements might be met:

(1) There may be an empirical pattern of behaviour in the demand for the product concerned (either of the firm or of all suppliers) which can be used for projection forward.

(2) There may be a stable pattern in (*a*) the proportion of personal expenditure, or of personal disposable incomes, devoted to those products, and in (*b*) the firm's share of that particular market.

(3) Failing the discovery of such regular or stable patterns, an analysis can be made of the reasons why the demand for the product varies, in the hope that the causal factors can be more easily forecast.

(4) Those who make buying decisions can be asked for their plans for the forthcoming period.

Usually there are no regular patterns in sales statistics which justify extrapolation. It is true that seasonal movements often show considerable stability but the trend of sales has to be forecast before the seasonal index can be applied. The demand for particular products may, for some periods, follow a fairly regular course. The moving annual totals of the value of manufacturers' sales of television from the year ended September 1949, to the year ended March 1952, moved along a straight line steeply upwards; then they changed course. The difficulty is to decide whether such a trend can be expected to continue. By the time this trend in television appeared to be established, use of it became dangerous! For durable goods generally, an assumption is possible that the growth of ownership will be a logistic curve, but the fit of such a curve to past statistics is usually nothing like perfect and when we are at the beginning of that growth, we find it very difficult to decide the maximum to which the growth will be asymptotic. This maximum keeps changing as the standard of living per person changes, the numbers in the population change, prices of the product vary, and tastes alter. Fitting such a curve may give an approximate idea of the likely course of events, but it needs to be supplemented by other information.

It is true that the broad pattern of consumer expenditure does not alter much from year to year, but when we break down personal expenditure into narrower classes of goods, the variability increases. After all, the pattern through time of the proportion of incomes expended on a product must be similar to the retail sales pattern, adjusted for any correlation between sales and total incomes. For necessities there is a greater stability in the proportion of personal incomes expended than for non-essential articles, especially durable goods. With a new commodity, the forecasting problem of deciding how far a trend now being experienced can be projected forward with any confidence remains unsolved. Moreover, one trend will affect another. The growth of television must affect the sales of ordinary sound radio, but, as the following figures show, the effect has been slow and radio has been clearly subject to many other influences:

	Percentage of Personal Disposable Incomes Expended on —	
	Television	*Radio sets and radiograms*
	%	%
1937	0.003	0.441
1938	0.007	0.434

	Television	*Radio sets and radiograms*
	%	%
1946	0.006	0.222
1947	0.023	0.339
1948	0.078	0.357
1949	0.129	0.314
1950	0.320	0.348
1951	0.485	0.346

Stability between statistical aggregates occurs when the only factors about which we are ignorant conform to a probability or chance distribution and other factors are constant. This probability pattern cannot be applied to business forecasts. Because a certain percentage of personal disposable incomes has in the past been spent on a product we must not assume that the proportion will, in the future, differ only as a result of a calculable sampling error. There is no population of homogeneous events under examination; other, known, factors are continuously changing and those changes have also to be forecast.

There is always a temptation to assume that an analysis of the causes of an event will provide a ready solution to the problem of forecasting. In fact, as we saw in the previous section, whilst such analysis increases our knowledge for the purpose of making policy decisions it does not solve the forecaster's problem. The demand for an individual product is dependent on so many factors that it would be remarkable indeed if this method proved to be more successful here than in the prediction of general business activity.

The explanation offered in most economic texts — that the demand for a product depends on changes in the price of that product and on changes in the level of incomes — is a considerable simplification of the conditions facing the business economist about to forecast the level of demand for his firm's products. The list of factors which may be said to determine the demand for a product is long:

(1) The prices of the firm's own articles. There are often many of different qualities, at different prices, being offered. This range of products is itself an important factor influencing demand. The appropriate price determining the demand for a product is really the minimum price in the available range. Persons able to afford the better quality articles at higher prices are unlikely to go without the product if they are withdrawn. The demand for a particular firm's products, however, is likely to be reduced if the better qualities taken from the range are available among competitors' products.

(2) The prices of similar articles offered by the firm's competitors.

(3) The prices of all other articles offered for sale.

(4) The disposable incomes available per head, or per household, according to the nature of the product.

(5) The numbers of those incomes or households.

(6) Changes in the tastes and preferences of consumers.

These six factors may be said to apply to all kinds of articles. There are, however, a number of additional factors which apply to durable goods. These are:

(7) The length of the consumption period of the article. With a durable good this introduces an important complication. The demand for any product is essentially a demand by consumers to replenish the stocks which, at prevailing prices and incomes, they like to maintain. With many products like food, drink, tobacco, toilet preparations, and the like, the period of consumption is so short that a change in price is generally and immediately felt. Not so with a durable good, which may have a life of perhaps ten or more years. Sales statistics are normally compiled in the conventional periods of months and years, but a change in prices or in incomes will affect only that proportion of people who are contemplating replacement of the product in that particular conventional period. The number of people who replace their stocks during a period of, say, a year, may be only a small proportion of the total owners. If the consumption period were absolutely fixed, replacement would occur simply at the end of that period from the date of purchase, provided prices and incomes and other factors remained the same. A rise in the price or a fall in incomes would affect this replacement demand by making some owners unwilling to replace their stocks. Because the consumption period of durable goods is not rigidly fixed, this would mean, in practice, an increase in the average age of consumer stocks. A fall in the price, or a rise in incomes, will enable those intending to replace to do so more easily. The effect on other owners would depend on whether prices had risen since purchase. Those who had postponed replacement would now be encouraged to replace. If prices had been continuously falling, or incomes rising, the effect would be, not on replacement (nobody need have postponed replacement), but on the growth of ownership.

(8) The period of growth in ownership. This increase in the number of owners of durable goods often takes a long time even without any change in prices or incomes, largely because of the long life of the product. Having bought one article (e.g. a refrigerator), the purchaser expects it not to need replacement for a long time, so he can contemplate the successive purchase of other durable goods.

The order of preference varies with different consumers. With a given level of prices, incomes and tastes, there will be a stock of each article which consumers intend acquiring but this maximum stock will take time to reach. This period will not necessarily coincide with the conventional periods in which sales are normally recorded.

(9) The effect of technical innovations on the period of consumption. An article may be changed so much as a result of technical progress or different styling that some consumers will wish to make an immediate or early replacement, even though their existing stocks have not reached the end of their days. This obsolescence factor reduces the average age of the stock. Examples are the introduction of vision in radio, and of micro-groove records in place of the normal-78 r.p.m. type. Obsolescence is a very important influence on the demand for capital goods.

(10) The effect of the secondhand market. An important difference between durable and other goods is that the end of the consumption period will often leave a durable good still of some value to somebody. This is especially true when it has been replaced because regarded as obsolete. The existence of a secondhand market increases the total consumer stocks (and the average age) by bringing products to persons otherwise unable to afford them and it reduces the replacement price of a new product by the amount of the secondhand price.

(11) The effect of hire purchase. The precise relationship between cash sales and hire sales is a subject in itself. Certainly the effect on total sales of *changes* in hire purchase facilities can be very substantial.

This list is not complete but it demonstrates the kind of factors which have to be considered for many goods. In order to make a forecast by this method of demand analysis, the business economist must, first, know the exact influence on the quantity demanded of each of these several factors, and secondly, have some control over those factors or be able to make a good forecast of each of them. Only a few words need be devoted to the problem of discovering and expressing the relationship between demand and the factors which determine it, because the really important problem in the present context is how to forecast the value of the causal factors. In this kind of analysis, the numbers of a commodity demanded are related mathematically to the determinants. This usually takes the form of a multiple regression equation with demand as the dependent variable (Y) and the n factors as independent variables, $x_1, x_2, x_3, \ldots x_n$:—

$$Y = f(x_1, x_2, x_3, \ldots x_n)$$

Let us disregard the question of the precise mathematical form of the equation. It is, of course, of importance, because it should express,

however artificially, the functional relationship which an *a priori* consideration of the causal factors would lead one to expect. The factors (7), (8) and (9), for example, must play an important part in determining the form of the equation for a durable good. To wrest these functions from the imperfect and scanty data which are available is, however, very difficult. For many of the factors little or nothing is known; for others, only rough estimates. Moreover, the functions must be derived from an adequate sample — from series extending back for a very long time. This means that the demand for new products cannot be functionally related to the relevant causal factors.

The important question is: can the independent variables in a multiple regression equation be forecast more accurately than the dependent variables? A firm has control over only one of these — the prices of its own products — and they are based on a forecast of costs and of demand. However, it has to fix the prices at which future sales shall be attempted so it must know what they will be for at least a short while ahead, (except that a product carrying purchase tax is liable to sudden change). All the other factors are outside the firm's control; they must be forecast. Yet, for all, there is no pattern which will automatically provide an accurate answer; the forecasts of each variable have to be obtained from an assessment, often very roughly, of the reasons why one order of magnitude seems more likely than another.

We saw in section three the improbability of accurately forecasting the general economic factors, ((3), (4) and (5) above). The general effect of technical innovations, cannot by the very nature of that factor be precisely assessed. It would not be an innovation if it had occurred before, so there can be no past pattern of experience from which to reason. The effect of different past innovations will not be of much assistance. The consumer's likely attitude to television, with most people already in possession of radio, cannot be gauged by reference to another generation's behaviour when radio was introduced. Similarly, the attitude of consumers to the availability of micro-groove gramophone records is unlikely to be the same as when records were first introduced; the environment alone has so completely changed. Gradual improvements in quality may be conveniently lost in a time trend 'catch-all', but a really important change should be treated as a new product, and for this there can be no equation. A forecast is almost wholly a matter of good guessing.

The remaining method of asking those who make the buying decisions what they intend buying, useful as it is for other purposes, has proved of very little value for prediction. The difficulty here is

that most consumers do not, in fact, make these decisions very far ahead. To do so involves a set of forecasts on their part of the likely course of a large number of events and these forecasts cannot be reliable. Forecasts of demand for a year or six months ahead obtained from market research are no better than those obtained by other means. The method is of value when, as with capital goods, the decisions cover a long period ahead. It may also be useful for assessing the likely reaction of consumers to changes in design and to the introduction of new products.

5. *The Importance of Judgment.* We can reason about the future only from knowledge of the past. Forecasting, in practice, cannot be accurate because our knowledge of the past is imperfect and incomplete, providing a most unsatisfactory analogy for the future. Moreover, as we have seen, the more we know about causal relationships, the more we realize that each factor presents a new forecasting problem. As with the Hydra's heads, the solution of one problem always involves the creation of more problems.

Forecasting must be a combination of factual analysis and guessing. A guess is not necessarily a shot in the dark; it implies a subjective, intuitive, assessment of the probable behaviour of factors about which we have no information. At all stages in making a forecast, personal judgment is indispensable and the reliability of the forecast will depend to a large extent on the reliability of such judgments. In our interpretation of the past, for example, we are forced, in order to simplify and make manageable our task, to abstract those factors which, in our opinion, are the most important. Some of these factors are not quantitative and of those which are, not all have been, or perhaps ever will be, measured. For this reason statistical analysis, by itself, may be highly misleading.

Worse than this uncertain understanding of the past, is the dependence of one forecast on an endless chain of other forecasts. At some point in this chain we have to stop and guess. We cannot go on pushing our analysis backwards indefinitely. In addition to the need for judgment in interpreting the past and in forecasting the behaviour of causal factors, judgment is indispensable when deciding in what respects the future will not be analogous to the past — for deciding, that is, how the future will be unique. We have to adjust the lessons of the past for new factors about which we can have no certain knowledge whatever. In forecasting the demand for radio, for example, we must not ignore the introduction of a new form of broadcasting with vision, yet, for predicting the likely rate of growth of television and its impact on the demand for radio and other forms

of entertainment, we have to rely almost wholly on our judgment. Some tit-bits of information may help us to get the right order of magnitude. We may have estimates of the proportion of incomes which people have, in the past, been willing to allocate to such forms of home entertainment and so we can get *some* idea of the proportion which might apply in the future to both radio and television together, after allowing for the special appeal of the new product. Similarly, to take another consumer article with which I am familiar, statistics of the sales per title of complete works on standard 78 r.p.m. gramophone records provide one basis for forecasting the sales of long playing micro-groove records. The information requires adjustment to take account of factors which are obviously not common — e.g. the ownership of appropriate playing equipment and the special appeal of the new product – and this adjustment is a matter of judgment, of good guessing.

Thus, forecasting in practice is very much a combination of knowledge and judgment. There is no *one* right method of forecasting; the methods vary according to the type of problem and the kind of product. The reliability of the forecast will depend on having available the maximum amount of knowledge and of being blessed with that flair called good judgment, which comes from long experience as much as from some special quality of the mind. The economist in industry can help in providing much of the required knowledge, but not all of it. Only the sales staff are likely to possess an intimate knowledge of customers' preferences and requirements, necessary for forecasting the demand for the firm's own products. On the other hand the economist will possess a knowledge and experience of interpreting economic events which others in the firm will not have. The economist can, therefore, collect all the required knowledge about general economic conditions in all the territories in which the firm trades and information about the market for the product concerned. The more knowledge we possess the better should be our forecast. The economist may well make good forecasts of cost changes and of the demand for the product in the whole market. The sales manager is certainly best fitted to forecast his share of that total demand.

The dilemma which faces business men is that they must make forecasts in detail, in order to plan factory output, yet they cannot eliminate forecasting errors. It is this uncertainty about the future which makes business risky and puts a premium on the person with sound judgment. Good forecasting is an art.

HAYES, MIDDLESEX

INDUSTRIAL ECONOMICS AS A SPECIALIST SUBJECT

by P. W. S. Andrews

Industrial economics is often, mistakenly, thought of simply as an 'applied' subject. To some extent, this results from a belief that the theoretical side of the subject is, or ought to be, adequately dealt with as part of general economic theory, and especially in the theory of value, the traditional core of economics.

It is true that the theory of value proceeds in terms of 'firms' and 'industries', and generalizes about the behaviour of these in certain assumed conditions and in relation to such economic quantities as selling prices, wages, costs and outputs. It is equally true that 'firms' and 'industries' must be the main entities in any theory of industrial economics. It would, however, be wrong to assume that industrial economics must *simply* be a field for the application of the general theory of value. In fact, I shall argue that the boot is on the other foot at the present time, insofar as general economic theory seems to me to be waiting on developments which are more likely to come about from the work of industrial economists following their own proper pre-occupations. To make clear exactly what is implied in these assertions, it will be necessary to go into some questions of economic methodology and take a view of certain aspects of the history of the development of modern theories.

The theory of value is one of the oldest departments of economic theory. We may define it tersely as the theory of the influence of non-monetary or 'real' factors upon prices and outputs. It may, on a first approach, be divided into a theory of the prices and outputs of commodities, or 'products', and a theory of the prices and employment of productive resources, or 'factors of production'. Since, however, human services are the only factors of production which are not themselves products, value theory may be said broadly to discuss the prices and outputs of *products* and the wages and employment of *labour*; wage theory, so far, has been very largely a secondary theory derived from the 'product' sector of value theory, and we may for the moment concentrate upon the latter.

Until a generation ago, price theory had developed two main branches: the theory of monopoly, where 'monopoly' was so strictly defined that it could ordinarily have no application to industrial products; and competitive theory. The latter developed into the theory of 'perfect' competition; allowances might well be made, and usually were made, for various 'imperfections', but these were simply

qualifications and had little effect upon the trend of the analysis, especially of long-run conditions. Competitive theory was constructed upon some rather severe assumptions, notably that, in any one industry, commodities were quite homogeneous, and that no individual business could influence the market price at which a commodity could be bought or sold.

A theory should, strictly, be judged by its results and not by its assumptions, for it is a mistaken view of scientific procedure to imagine that this demands that assumptions must be 'realistic'. Where realism is required is in the conclusions, and, at that level, a better name for the quality in question is 'validity'. The validity of a theory is entirely a matter of the extent to which it is a better predicting instrument than any alternative theory. This is as true for the descriptive parts of economic theory as it is for any other scientific activity.

The general validity of the theory of value in perfect competition was shown in the success with which economists came to be able to forecast the effects of the major influences at work in commodity markets. The fact that its doctrines had to be modified, in application, by doses of practical wisdom is not, in itself, a criticism; it was the theory's general validity which made it possible for economists, as such, to get their practical wisdom.

In its modern forms, however, theoretical economics has long included other types of analyses which purport to describe or predict phenomena with which it is less easy for an economist to get the sort of practical acquaintance which is broadly possible with commodity prices. The theories of wages and of the distribution of income are examples, but the most important instance from our present point of view is undoubtedly 'welfare' theory. This is the branch of economic analysis where economic situations are considered in order to formulate policies which might be recommended as tending 'to increase economic welfare'.

Whatever the justification for such extensions of value theory, it is, surely, clear that the validity of these secondary analyses must depend upon the validity of the assumptions from which they start. These assumptions were embodied in a theory of the behaviour of individual businesses in perfect competition. Using a fundamental method of economic analysis, this theory studied a hypothetical individual business on the assumption that it always moved to a position of equilibrium, getting to the best possible position according to its own interest in the face of the various economic forces at work in its economic environment.

Now, the full development of such a theory of the firm had not

been strictly necessary to product-value theory. In the work of Alfred Marshall, certainly, it had proved possible to restrict the assumption of full equilibrium to forces working at the industrial level and to avoid assuming that *businesses* always tended to be in the optimum position theoretically available to them. But, as Marshall's own work shows, when it came to secondary analyses derived from value theory, it was necessary to work in terms of the individual business; that was the basic unit of economic activity and the one which the secondary analyses necessarily had in common with the value theory from which they were derived.

The result was that, in academic teaching, this theory of the individual business in perfect competition came to have a logical primacy in value theory as well as in secondary analyses. This made possible the logical integration of the whole of 'pure' economic theory and enormously simplified the teaching problem. The result was that even value theory itself appeared to be *based* upon a particular theory of the firm, whereas the latter was really simply a reworking of certain elements of value theory.

Seen from this standpoint, the theory of value in conditions of competition as developed by Marshallian economists, appeared to lead to serious logical inconsistencies; which was why Marshall had *not* based it on the idea of full equilibrium in the individual business. In particular, Marshall's theory of competitive prices was general enough to include both ordinary manufacturing industry and primary industry. It, therefore, recognized cases where costs of production would fall with sustained increases in output. These came to be seen as having considerable practical importance. Since the theory of perfect competition with full equilibrium in the *individual business* could not incorporate an assumption of falling costs (for, in this case, in the assumed conditions, a business would never get to any equilibrium but would always be expanding) theoretical economics until very recently has abandoned any general approach to manufacturing industry through competition theory.

What has happened is that we have retained the basic notion of individual equilibrium and have altered our assumptions so as to permit of falling costs in this case. Because of the continued use of other assumptions, this has entailed a general approach to individual businesses and to manufacturing industries in terms of individual 'monopolies', and of outputs being limited, despite falling costs, because of the fall in profits which would occur if expansions were forced on the marketing side. This theoretical revolution has not so far succeeded in producing a theory of such broad application as the older competitive approach to industrial values. Meanwhile, the

approach *via* the individual business has so blurred the older generalizations that economists now seem to have little confidence in them even as a first approximation to practical problems.

Fortunately, matters have not stood still. The introduction of 'realism' into the theory of the firm has made it vulnerable to further injections. Empirical work has begun to make us realize that there are important competitive relations between businesses which are not taken into account in the static particular equilibrium theory we have just been referring to. Any positive step forward is still a matter of acute controversy and the possibilities need not be discussed here. What is relevant is that, although the 'atomistic' theory of business still seems dominant if we look only at the positive theorizing of modern texts, we can yet see the breach in the wall in the admission of the existence of widespread elements of 'oligopoly' — competitive relationships involving relatively few businesses. Now, oligopoly theory has long been something of a technical toy just because no general theoretical solution can be found, and the admission of its importance is consequently the first sign of the breakdown of a theoretical approach to prices in practice *via* the assumption of a determinate full equilibrium in the individual business.

It seems reasonable to suggest that a new start has to be found. For one thing, economics needs a workable approach to prices in general; for another, it needs a workable theory of the behaviour of the individual business. I venture to suggest that this approach will only be found through empirical work on actual businesses. To get the theory we need we cannot continue to tinker 'realistically' with what was originally a derivative of theorizing at a different level. We need to approach the matter in a more truly scientific manner. If we wish to theorize fruitfully about individual businesses, we must find out what are the facts of their behaviour and then construct a general theory especially in order to take account of those facts. As I have already said, much new thinking is already going on, and it is significant that it has been stimulated by empirical research work, especially in England and America. If this is not the occasion to enter upon a lively controversy, one may at least observe that industrial economics seems to be coming into its own.

To return to the point made at the beginning of this article: industrial economics is most certainly not just an 'applied' subject. Few, if any, would now seriously maintain that existing theory provides the industrial economist with a box of 'tools' which he has only to apply in his own sphere. His main task, of course, is the scientific one of giving valid generalized descriptions of industrial phenomena.

It is significant that, in some recent discussions, would-be protagonists of existing theories have said, in effect, 'if this is not how the industrialist behaves, it is how he *should* behave in his own interest'. Even from the point of view of private welfare theory, this evades an important point raised by empirical research, that the industrialist does not generally know, and, it may be argued, could not find out, some of the important criteria in terms of which he would be assumed to assess his gains. For our more objective purposes, however, the important thing to notice is the tacit admission that industrialists do not, in fact, behave as predicated.

Further, if it were true that economic theory already offered an adequate general theory of the firm and of the industry as units of activity, whilst that would be of very great help to the specialist, his work would still have a theoretical side. He would still have to do more than test, verify and apply theories produced elsewhere. The sharpening of his focus must necessarily make him more interested in details than would be relevant for general economic theory, and he would need correspondingly more detailed theories. It should certainly not be assumed that he could simply derive these detailed theories from any more general theory. When an analysis changes its level of abstraction there is no reason why the character of the analysis should remain unchanged.

If we agree on the importance of a continuous development of theory, there is little doubt concerning the way in which it may be encouraged. The kind of economic theory which is most useful to industrial economics as a specialist subject will be best helped forward by concentrating attention on empirical studies. This also, as we have argued, will be of the greatest possible service to economics in general. If physical sciences move forward in the laboratories, economics, and especially the economics of industry, will advance in proportion as it is possible to hasten the assembly and discussion of empirical experience which is relevant to its theoretical needs. Accordingly, it is no paradox that, after having been so concerned with theoretical issues, I should end by urging the importance of empirical work.

Just as the theory of industrial economics must start with that of the individual business, so the subjects of specialized interest are bound to be headed by those which have direct relevance to the conduct of individual businesses; among these are: the pricing of products; the development and marketing of products; the location of new enterprise; the organization of production; the payment and organization of workers; the planning, carrying out, and control of expenditure upon capital assets; the supply and use of financial

resources; and the general organization of management in the individual enterprise.

This list calls attention to the fact that, because so many of these subjects are of direct management interest, in its efforts to improve efficiency and lower costs, they are nowadays studied also by persons who give professional advice about them. Industrial economists themselves, because of their experience, are increasingly proving of service to businesses in this manner, even if not always as professional advisers. Nevertheless, the direct interest of industrial economics in these matters has a different orientation. It will be interested, of course, in the work of such advisers to the extent to which they are building up systematic views of the methods by which the dynamic efficiency of businesses can be improved. Above all, however, as a branch of a social science, industrial economics will be interested in what actually happens, as distinct from what should happen in hypothetical or ideal circumstances.

This interest may not be met by 'organizational' descriptions of the present positions of individual enterprises with respect to any one of these subjects, although a comparative study of the differing positions of a number of enterprises, properly selected, will help us to answer the question how the position in any one business, on the average, tends to change with changes in other relevant factors. Such questions are answered more directly in case studies, which bring out the factors or circumstances through or in which the changes in question have been brought about.

Our list so far has been directly concerned with the individual business as such. The subjects listed will, however, have reminded us that industrial economics has a lively interest in the relationships between individual businesses. (It would indeed be a poor study of even an individual business which neglected to look at such questions.) One thinks at once of competitive relationships — of the ways in which many prices, for example, emerge out of the competitive struggle between businesses. But, in fact, even in very competitive industries it is important not to overlook the complementary relationships which exist as well; and in other cases relationships between businesses would, of course, be more formally regulated by collective action. Here again we shall be helped by the making of empirical studies of the changing positions of individual businesses. Indeed, these are essential if we hope to get at the influence of the general economic factors which, to continue the example, may effectively set limits to the prices which can be realized, but which may be lost in the background of a view of the position at any one time.

One of the difficulties with which we have to contend is that

detailed case studies of many of these topics involve the elucidation of intimate details affecting individual businesses and full publication of an identifiable character may not be possible. The industrial economist may well get confidential access to such facts, and he can contribute directly to our subject by generalizing from the cases which he has studied. So can the professional advisers already mentioned.

In the present state of our knowledge, and even in the interest of industry itself, it is, however, very desirable that more should be known about the way in which industry sets about even its most intimate tasks, as well as about the facts of industrial experience generally. With the reduced secretiveness of industry, unnecessary obstacles to these studies are passing away. Much more can be done in the way of direct publication than has been done so far. The real obstacles can be met in various ways. Often, it will be possible to discuss a case with practically all the detail which an economist requires, if it is subjected to a 'bowdlerization' which removes identity or generalizes about really confidential details. For all this, our subject depends upon the co-operation of business men. They can also help by contributing directly to the discussion of industrial problems, drawing generally upon their experience.

These references to our subject as being advanced by publication and discussion bring us directly to the part to be played by this journal. The *Journal of Industrial Economics* has been established by its editors and publishers in the belief that it will be of value as an academic periodical specializing in the economics of industry in the widest sense. As such, it must aim at being international in scope. Its Anglo-American foundation seems especially fitting, in view of the extent to which industrial economics has developed as an academic study in the United States, and of the traditional importance of the subject in the curricula of both countries.[1]

From what has been said already, it will be seen that this new journal may be expected to have a detailed and empirical interest. Even its theoretical articles will usually be concerned with some particular problem, and will for that reason usually carry practical implications. On the other side, as has also been indicated, it is intended that the empirical articles shall be acceptable on the basis of their relevance to the theoretical tasks before us. We intend to offer a medium of publication for the increasing academic research into industry and commerce. Equally, we hope that a good many of

[1] That we have only one American article in our first number is due to a production time-lag (the *Journal* having been mooted on this side of the Atlantic before the possibility of the joint enterprise was discovered) and not to any expressed lack of interest on the part of American authors. We hope gradually to redress the balance.

our articles will arise from within industry itself. In this way, we hope to make available some of the material and experience arising within businesses which is normally lost both to academic researchers and to other business people.

A journal run on this basis may reasonably hope to have business men among its readers. It is hoped that they will also appear in the more active capacity of authors, being encouraged to make their contribution to the discussion of the detailed problems in which the *Journal* will be interested, and on which they, being the subjects of our theorizing, have so much that is relevant which they can tell us.

This reference to business men as such may remind us of a most important point: much has been said in the abstract of 'the industrial economist'; it would be unfortunate if this left too clear a picture of such persons as necessarily being academics. Nowadays, we have increasing numbers of trained economists working in industry, a growing proportion of them as economists. Here trained persons are acquiring practical experience in the best possible way. Although the position seems to be better in the United States than it is in Great Britain, far too few of these alumni of economics have contributed to the wider development of our subject from their own experience. Their silence during a generation in which the theory of business has been so much discussed may be a tacit tribute to the remoteness of much of the discussion itself from the actual problems and situations of businesses. Be that as it may, it is time that the position changed and that economics began to draw upon them for its own development and progress.

There is one final point which should be made. The discussion so far has been almost entirely in terms of problems of some permanent theoretical interest. A fair proportion of our space should certainly go to these, but industrial economists must also be interested in what is going on in their subject-matter generally. We shall, therefore, publish articles of a more contemporary interest dealing with some of the important problems of industry today.

Having thus passed from our strict subject to the question of the *Journal* itself, the author bows to the instruction of the General Editor — that he should leave the *Journal* to speak for itself, having first commended it to the indulgent favour of the reader.

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TOWARDS A EUROPEAN ECONOMY[1]

by Paul Rykens

It is one of the most gratifying developments of our time that the word 'foreigner' is gradually losing its unpleasant sound and is being replaced by the word 'European'. In the economic sphere too it sounds out of date nowadays to talk of a 'foreign undertaking'. International co-operation, which means a break with narrow nationalism — one might say provincialism — is nowhere more intensive than in European undertakings, which are one of the most effective cementing agents in the structure of the Western world. In such businesses as my own it is already necessary to discover in people of different nationalities those capabilities and talents which are essential to a flourishing undertaking and to build up in co-operation with them something that is good and valuable. This can be done, in Europe and in the world generally for that matter, only on the basis of efficiency. Nowhere does an international undertaking occupy a privileged position; its sole protection lies in the value of its products to the consumer, in the importance of its activity to the economic potential and the standard of living of each of the countries which offer a sphere of activity to the undertaking. This demands of the management keen observation of markets, constant watchfulness, adaptability and inventiveness — things which can only be maintained by drawing on the available talents of all nationalities. The opportunity thus given to the individuals to develop in turn awakens talents which prove to be of international value. In my experience as a European businessman, the flinging open of frontiers means a real release of latent forces, an opportunity for the worker, the expert and the businessman to exchange the fruits of their abilities for the best that other nations have to offer. A big market allowing of thorough-going division of labour and constant exchange of technical and economic experience between the nations creates, in Europe as elsewhere, the conditions necessary for greater prosperity and for an immense increase in the material and labour potential. All this is not purely on the material plane; it also involves an enrichment of experience, a human adventure of the very highest value.

But if we want to become Europeans, and progressive Europeans at that, for there should be no others, we shall have to get rid of some old habits and acquire new ones.

[1] This paper was originally read to the German Society of Economic Policy at Frankfurt-on-Main on January 17th and 18th, 1953.

As a general thing, and in the economic field in particular, we must get out of the habit of thinking in terms of opposing interests. In the new Europe there should no longer be any place for the delusion of collective opposing interests. This, of course, applies particularly to distinctions as between nation and nation. We often hear empty remarks about the threat to, say, 'British industry' or 'Belgian industry' by 'German industry' in the event of the complete integration of Europe. The truth is that certain German industries will be found to be more efficient and others less efficient than their European competitors. The first-mentioned industries will expand considerably, others will have to curtail their activities or else make themselves more efficient. Either eventuality will benefit the German people, which on the one hand will get more scope for development and on the other will have its needs more efficiently met. It is not as if certain countries would have all the advantages and others all the disadvantages from integration. The attribute of efficiency transcends all national distinctions. No longer will 'the German glass industry' compete with 'the French glass industry', but Company A, which may be Franco-German, will compete with Company B, which may be working with British and Belgian capital.

On the European level the question of where the capital comes from is becoming less and less important. Whereas so-called 'foreign capital' used mostly to be regarded with a certain amount of mistrust, it is now extremely welcome in practically all countries. Thus the 'opposing interests' idea is dying out in the field of financing too.

But the most important antithesis that has to be banished from our minds is the alleged incurable tension between capital and labour. This is one of those obsolete nineteenth-century ideas. Capitalism and Marxism made their appearance in Europe simultaneously; capitalism, so to speak, created Marxism. But what hardly any Europeans seem to grasp is that the period of capitalism — and of Marxism — is already virtually behind us. It came to an end in the 'thirties. The autocracy of capital in economic life was then finally broken; in addition to the trade unions and the independent 'manager' class the government departments appeared on the scene as a co-determining factor. The extension of capital investment to other parts of the world on the wings of expanded political power — imperialism — has been thwarted. In the world of today there can no longer be any talk either of imperialism or of the powerlessness and progressive impoverishment of the worker. The worker need not envy the owner of capital, be he shareholder or debentureholder, his influence on the business, for in many cases this influence

is very slight, almost too slight. And so far as return on his money is concerned, if we compare the earnings of labour and the return on capital with the movement of prices since 1938, we find that wages have more or less kept pace with prices, whilst the real value of dividends and also of share prices has lagged far behind.

Then what about the class war? In a certain sense there is one, but it is an illusory antithesis which in the light of European economic unity is bound to vanish in the same way as the others. We ought rather, perhaps, to speak of a certain unease, of a tension born principally of a sense of fear and suspicion and having no concrete foundation in the economic structure. Also, this tension exists not so much between the employer and his employees as between employers as a group and trade union leaders as a group.

In my opinion employers often worry unnecessarily about the demands made by the trade unions. Sometimes the mere existence of trade unions still seems to be a thorn in the flesh to them. We must remember, however, that modern society could not function satisfactorily at all without trade unions. Wage negotiations are possible only on a collective basis, and the trade unions are the appointed representatives of the workers' interests. Even if the employer does not see this, it is quite pointless to want to undo developments such as the trade union movement. The patriarchal epoch belongs to an even more distant past than the capitalist era. That trade union leaders can be responsible and reasonable men who have the general good just as much at heart as the employers is clear from the way things have gone in several countries. In Sweden the top associations of employers and workers have for many years past been working together for the settlement of disputes and the efficient functioning of the works council system. In Holland the top associations have even formed a joint organization on a parity basis which advises the government on all matters of wage policy, and this organization is largely responsible for the social peace that has existed in Holland since the war. In the United States the trade unions are striving for a considerable improvement in job training for young workers. In general it may be said that trade union leaders — like other human beings — show just as much moderation and reasonableness as is expected of them.

On the other hand, however, the trade union leaders must realize that in the employer they are not confronted by a capitalist, but by the leader of an enterprise — a 'manager' like themselves, except that he has a different sphere of activity and a different responsibility. This manager too has a perfectly legitimate *raison d'être*; it is his task in society to enable the functioning of that indispensable complex of

human beings and means of production which is known as an undertaking. In this respect there will be little perceptible difference between the good head of a State undertaking and the good head of a private enterprise. The primary concern of both is the sound functioning and continued existence of the undertaking. It is the latter's interests that they have to safeguard, and sometimes to protect against excessive demands, whether from the tax authorities, the workers or the shareholders.

A trade union leader does not as a rule take kindly to anyone trespassing on his ground. But the same applies to the head of a firm. He too can only carry his responsibility if he is allowed to take critical decisions himself. This does not mean, however, that the workers in an undertaking should be treated as 'minors'. On the contrary, the good employer refers to his workers and staff in all matters which also affect their interests and their fate; he consults with them in matters which the people on the job perhaps understand better than he does, or on which they may have a different slant, and gives them information about the position of the particular branch of industry and of the undertaking. This awakes in the employees a new interest extending beyond the narrow sphere of wages and working conditions.

All this, however, does *not* primarily depend on the clauses of any particular law and if I, as a non-German, may say so, I hope that European collaboration will result in an osmosis of social and operational ideas which will wean employers and trade union leaders away from any tendency to attach exaggerated importance to laws in the regulation of human relations, such as seems to exist in Germany today.

Finally, in the European sphere we must also get rid of the habit of looking to an ever increasing number of organizations and to planning as the best means of raising the standard of living. What is needed, first, last and all the time, is production, reduction of costs and adaptation to requirements. These things cannot be achieved by organizations, committees and associations, but only by an alert and flexible European economy subject to the dictates of healthy competition. The European economy in this sense is the complex of workers, providers of capital, and employers; this, under the guidance of the employers — who after all are the conductors of the orchestra — and under the supervision of public opinion, functions in the interest of the European consumer.

Then has planning no place in all this? Yes, it has, but no longer the kind of planning which is governed by purely national considerations and is often at the expense of the economy of other parts

of Europe. National policy retains its importance as a safeguard of certain local interests within the framework of the European order. Really radical planning, however, should where necessary — for instance, to fight an economic crisis — be not merely European but 'Atlantic' and, if possible, world-wide.

So if there is much that we have to unlearn, there are perhaps also new things that we have to learn. They are implied in what I have already said — the new standards are mostly the opposite of the old ones.

I would, however, like to say explicitly that in my opinion Europe must take the offensive, both mentally and socially. We have a bigger labour force than the U.S.A. and a larger production machine than the U.S.S.R. Both of these we would quite definitely like to use purely for peaceful purposes as soon as our freedom and independence are secured. Europe has not only a great past but also a great future. She must, however, make up her mind what sort of society she really wants. This can only be done by thinking unfettered by dogma. Many of Europe's stock political ideas are obsolete and worn out. Yet the hope of a fundamental renovation of political and social life which blossomed during the War and in the immediate post-war period has died again in most countries. The old forms have mostly been found to be too strong. But still — there is often new life to be found in old forms. It is a comforting thought that there is agreement on extremely important elements of social and economic policy between leading personalities from entirely different social spheres and of completely different political opinions. Therein lies the hope that by undogmatic thinking and acting we shall achieve a consolidation of forces, thus bringing about the new society without overthrowing what is out of date but simply allowing it to die.

To start with, the keynote of the European society must be freedom. There is no other way. At the moment there exists in Europe a number of national economies organized and regulated from different points of view and to some extent protected from one another. If we want to unite Europe we have the choice of two methods: we can stitch Europe together or we can let her grow. It would be a patchwork job patiently to join together threads unravelled from national patterns which do not match at all. The number of joins to be made would be so large and the parts to be joined so diverse that it would be an impossible task to undertake all this deliberately and from central planning points. The other method is to scrap national regulations in so far as they are not required for European unification and take vigorous action to give Europe room to grow of itself. Life is pulsing strongly enough in the

European economy; all it needs is room and freedom to develop. A natural and healthy European economy can only come about if industry, agriculture, trade and commerce are first and foremost allowed to find their own pattern, though under the supervision of governments and public opinion. If during the transitional period it should become necessary to assist certain sections in order to avoid unnecessary hardship, measures for that purpose should be taken on a European level and expressly limited as to time. Europe will never materialize unless organization on a national basis takes a back seat so as to allow new life to grow freely across the frontiers.

In this process each country will have to absorb new, or only seemingly new, truths. One of those truths is that good and cheap imports, especially from other European countries, should be extremely welcome. Although work is a blessing, it is not an end in itself. In the last analysis the entire economy exists in the interest of the consumer; this should be one of the cardinal points of the European economic order. It will result in considerable, where possible complete, freedom of movement of goods in the European sphere. This freedom should also be extended to capital and labour. The choice of the most favourable site, the forcing down of production costs, free scope for ability and industry — all these are indispensable elements for a healthy European economy which will raise the social product to a level not hitherto reached. But it is essential to recognize one fact: that in economics, the good thing is what serves the consumer.

But should this freedom not be kept within any bounds? Certainly it should. The bounds should consist of a European order and a European code of ethics. Order is indispensable if we do not want to fall into anarchy. Order, however, is not the same thing as regulation. The organizations must exist to operate a European economic policy and these organizations must make up their minds what are to be the main lines of this policy and by what means it is to be carried out. The most important means of all would seem to be the readiness of the individual States to waive national prestige and national ambition and become members of the team. Planning on a European level will be necessary, but planning in the sense of forward-looking consultation. Control in the sense of detailed intervention will be impossible, but economic policy need not do without the essential regulating tools required to keep the whole in equilibrium. Such planning should at all times include freedom; its principal aim should be to increase not only European production but also European self-esteem. This can only be done by releasing all the latent forces.

The European code of ethics which should govern the actions of statesmen, businessmen and trade union leaders is simple enough in itself. These are some of its elements:

The good of Europe as a whole comes before national interests.
Social solidarity is essential: it must relieve the economically weaker groups of their fears about European unification.
Social solidarity must not, however, express itself in a manipulation of the price system.
Any help to specially endangered groups must be given only temporarily and in a constructive form.
The nucleus of the European economy, the individual undertaking, must develop into a live and integrated community bringing satisfaction to all the people working in it.
The particular function of every leading group in the economy — employers, providers of capital, trade union leaders, public authorities — must be expressly recognized.
While the special interests which each of these groups has to safeguard are fully recognized, peaceful collaboration in the interest of the consumer must take the place of conflict.
In European relations between the different groups of society and the different nations mutual good faith must always be assumed.

Within such a framework we could safely allow freedom to reign and Europe to grow. But the old does not disappear of its own accord and the new framework does not come into being automatically. It requires a very definite impulse. We are in the midst of a dramatic development which in the principal countries is being borne on the shoulders not of the masses but of a comparatively small number of leading personalities. A great responsibility rests on the economically and culturally privileged in this critical time: they have to be nothing less than the bearers of European progress. May they measure up to this task and embody the European concept in their own lives.

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GROUP INTEREST AND MANAGERIAL ENTERPRISE

by Oswald W. Knauth

Experience in management has led to views about the nature of the modern large enterprise and of the relation of stockholders to management and of management to employees, customers, and the government, which are at variance with those which underly the received doctrine on the functioning of the market system. The purpose here is to elaborate these views and interpret their significance with respect to the incentives and restraints on management and the essential character of market processes, both for goods sold and for services bought.

A new relationship has evolved in the large, publicly owned corporations, which has separated stockholder from management. The corporation has become a quasi-permanent institution, centring around a continuous flow of production and distribution, rather than a disconnected series of purchases and sales. Not individual transactions, but policies to insure permanence are the dominating force which control the action of the management. Not individual smartness, but long range wisdom and planning are required for success. Profits are essential for continuity, but equally essential is the establishment of a trade position which will facilitate future transactions. The perfect transaction must result not only in profit but more importantly in good will. The policies of the moment are derived from the past and also set the stage for the future. The rate of production depends on the stability of the rate of sales, for if sales decline, production cannot go on. The object of management is to achieve a balanced flow at as high a rate as circumstances and ingenuity permit.

The separation of management and ownership has deeply affected the structure of the corporation and the relation of the different groups to each other. Legally, the stockholders elect the directors. Typically, the directors are a self perpetuating body, whose actions are approved as a matter of course at the meetings of the stockholders. Only a modicum of success is necessary to keep any management in control. Owing to lack of organization, stockholders are almost without power to bring pressure on management. Indeed, the other groups whom management has to satisfy are better situated to exert influence. Customers can find other resources for their purchases. Government can harass managements with regulations, can demand reports and documents, finally bring anti-trust suits. The public can

adopt a hostile attitude which hampers operations. Not least of these pressures is exercised by employees in the enforcement of their demands.

Subject to all these pressures, management has come less and less to consider itself responsible to the owners and more and more to accept responsibility for the corporation as a whole. It does not oppose the demands of the other parties in the interest of the owners, but on the contrary, attempts to satisfy them all — dividends for stockholders, high wages and good conditions for employees, friendly relations with government, an approving public, customers who will return for future purchases. In a sense, such a point of view might be interpreted as enlightened self-interest of management, or enlightened stockholder interest, but typically it goes beyond that in the interest of permanence.

Two generations ago — prior to 1900 — management as the trustee of owners bargained with labor — as it did with those who sold or rented land, constructed buildings, lent money, supplied raw material or purchased its products. Bargaining was the essence of free economic enterprise. But while managements had to bargain on equal terms with all of those with whom it did business, it would be a travesty to say that it bargained equally with labor. It *told* labor — especially unskilled labor. In some degree management had to bargain with skilled labor, for skilled labor was scarce and important; it had the rudiments of organization; it was deired by a competitor, to whose blandishments it might succumb. But unskilled labor stood in line waiting for jobs.

Machines were not too plentiful, so that heavy work was done by broad backs. Management was identical with ownership — the biggest owner or the ablest, of a small group of stockholders, was president and general manager.

Invested capital was not yet large and mostly of the general purpose variety — having value for other purposes in case the venture proved unsuccessful. The owner-manager was typically bold and resourceful. He was ready to move in any direction that appeared expedient. Provided he stayed within the law, his responsibility to others weighed lightly on his conscience. His main problem was production. It was an economy based on scarcity of goods. In each transaction he tried to maximize his profit. The objective was to increase the value of assets, and he considered the last figure on his balance sheet — the growth of surplus — as the only figure that counted. Profits could be directly measured and controlled. When orders were slack, he reduced his labor forces; when plentiful, he worked them overtime.

This structure of the economy at one time universal survives in shrinking circles — in small towns, in fringe industries, in speculators, commodity brokers, dealers, inventors, innovators, persons of talent — wherever the advantage of cleverness and mobility outweighs the advantage of position, reputation and production efficiency. Profit is gained through a series of transactions, each complete in itself.

This individual free enterprise no longer dominates the economy. Indeed, the organized — and growing — majority of the economy operates under an entirely different set of conditions. As the size of industry grew, with specialized machinery, heavier capital investment, the production-line, it demanded a skill of management that was not often found among the second and third generation of stockholders. More and more management drifted away from stock ownership, until today typically it is completely divorced. More and more, as management became professionalized, it perceived the necessary connection of a permanent industrial organization with all its component parts — employees, suppliers, customers, government and the public in general.

With the introduction of mass production and the accompanying production line, the character of industry changed. It ceased being a process that could stop and start up again without much loss. It became more and more a flow of goods, for some industries a flow around the clock. More and more machinery was devised for the routine processes. Once adjusted, the machine did the rest, and needed only tending. When a general readjustment was required the entire plant had to be shut down, and the flow stopped. Such a necessity was postponed as long as possible.

The task of management changed. Clever bargains lost their importance. Rather, the regulation of the flow became the dominant concern. And in fulfilling this function, management was driven further and further afield. The flow within the factory could be organized but the external flow had also to be brought into line. Supplies of raw materials and semi-finished parts had to be arranged so that they came in at regular intervals. A system of distribution to syphon off the product had to be organized. This took many forms: dealers, customers, the mass-selling institutions; advertising; price adjustments; packaging. Every device was sought that appeared to contribute towards a steady flow of distribution in balance with the relatively fixed flow of mass production. It marked the transition from 'selling' to 'marketing'. The vice-president in charge of marketing equalled or outstripped in importance the vice-president in charge of production.

In the field of accounting the balance sheet was replaced as the major source of judgement of value by the income statement. The balance sheet was intended to indicate value at a pin point of time. The income statement concentrated on the estimate of income over a period of time. Neither of these concepts is true in itself; but the income statement has proven to be more useful than the balance sheet.

In a permanent flow of production, success is achieved through a continued readjustment of the component parts to each other. Management constantly searches out the weak links in the chain as they manifest themselves. Tendencies indicate the cure for corrective action. If costs increase, better methods or higher prices are called for, depending on the judgement of management. If sales fall off, new efforts at marketing or an improved product must be made. Profits are the indirect resultant of success in adjusting the balance of forces — not the direct objective of a series of negotiations.

The first task of management is to create a successful product — useful to a wide circle of customers. The second — and subsidiary — is to divide the proceeds of success to each of the component parts of the organization: to the suppliers in order to keep the raw material rolling in; to the employees in order to achieve the highest rate of production; to the customers, in order to maintain their enthusiasm; to stockholders, in order to attract new capital when expansion is needed; to government and the public in order to maintain a friendly atmosphere for operation. Success implies the satisfaction of all the parties. Lack of success causes the disgruntlement of one or several of the parties. In that case, the degree of immediate pressure which each can bring to bear determines the division of the product. Some one gets less than he considers his share.

In this respect, the customer usually stands in the strongest position. Almost always he has the possibility of substitution — at times even of refraining from purchase. To meet his conditions is fundamental. Next, come the suppliers. In so far as their products have unique qualities essential to the finished product, they can impose the terms which management must meet. From such a condition, management has in various degrees all the advantages of bargaining which every buyer has in relation to the seller.

Third, come the employees. The pressure they can bring to bear has turned a complete cycle in the years since 1900: from a helplessness that was well-nigh absolute to a dominance that is all but absolute. The losses due to a stoppage of production affect not only the industry, but include a wide circle of the economy.

Fourth, come the stockholders. No less complete has been their cycle from dominance to helplessness. They have no voice in the decisions that management sees fit or is forced under duress to make. A dislodgement of management is for all practical purposes out of the question. Stockholders have all but lost the rights that are associated with ownership. By selling their shares for what they can, they retire from the field. Otherwise, a feeble protest at annual meetings is the extent of their power, and their proposals are normally overwhelmingly defeated by the proxies which management has been able to accumulate at the expense of the corporation. There is no management-stockholder joint bargain over the rate of earnings or dividends.

What has occurred through a series of slow steps over half a century is a complete change in the economic structure and philosophy of the permanent corporate management without any change in the legal philosophy through which it operates. Stockholders are legally still the owners, tied in with managements, even though they have separated. Employees are still legally independent even though they are closely meshed into the corporation by union contracts, security rights and pension provisions.

While these changes were gradually transforming the technique of the economy, theory and law were standing still.

Government laws are administered in relation to specific unrelated acts even though the corporation has become a permanent entity of many parts closely interwoven into each other with continuity of flow as the main objective.

Many economists still regard the management's acts as determined by the maximization of profits even though maximization is impossible to compute and profits have become only one of multiple objectives.

Where then is the solution to this curious and unsatisfactory condition into which our industrial complex has drifted? Basically, what is required is a complete overhauling of theory to explain the facts and implications of the new relation between groups which has evolved. Only then can the law be revised to protect the social interest in relation to the system of industry. Such a law would have to take into account the actual relations between management stockholders and employees. It would even have to go further and include outside interests, where these are affected. At present we are drifting in a morass of strange court decisions as to what acts are legal or illegal.

Among the incongruities is the accepted method of settling wages and conditions through so-called management-labor collective

bargaining. This is bedecked with all the paraphernalia of grievance, demand, refusal, negotiation. It results in a strike or a new contract with government playing an uncertain and unenviable role. Were management identical with ownership, such a method would be entirely appropriate. Either side would have the power *not* to conclude the bargain, and walk out. Labor would find other jobs, and the owners would sell out as best they could. The possibility of a refusal to agree is the essence of a free bargain.

Let us examine the postulates underlying the bargaining method in a competitive, free economy of settling industrial disputes. Both sides must be free to enter into a contract or not to enter into it. The power of both parties must be so limited that the general economy and the public is not affected by the dispute or its outcome. The ability of both sides to accept an alternative must be relatively equal.

All these conditions are fulfilled in many bargains, such as the dickering over the price of a house between owner and possible purchaser. They are also fulfilled in bargains of a small factory, or service company.

Obviously, these are not the conditions controlling the normal collective bargaining procedure. The stoppage caused by a strike in any one of many large corporations ramifies in many directions. Many persons and businesses are forced to suffer discomfort and loss. Such a strike is more than a test of strength between the parties. It involves a large segment of the economy which happens to be dependent on the flow of the product of the industry. These persons have nothing to win — they can only accept the losses and discomforts imposed on them. Such public losses are serious enough when any large corporation is involved. But in an industry-wide bargain and strike, they affect everybody. There is no industry that, taken *as a whole*, cannot cause wide general stoppage and loss. Clearly, management has no place in the bargaining over the division of the income of the corporation, for management as shown above has come to represent the corporation as a whole, not any one of its component parts. The bargain over division of the product is primarily between stockholders and employees.

The logical counterpart of this recently developed position of management is that it should be the impartial chairman. Management is concerned with the division of income between stockholders and employees only so far as it contributes to the smooth functioning of the corporation. In such a situation, stockholders would be represented in the bargaining over wages by a committee of their own choice, just as labor is represented. The interest

of management is to try to satisfy them both, to the extent that the prosperity of the company would permit.

Furthermore, the developments of labor-management conferences have thrown management into the false position of being opposed to its own employees. That is not the case. Management is just as eager to have contented employees as it is to have contented stockholders. Its professional standing is at stake. Its competence is judged by its contribution in raising the standard of living of workers, in increasing security, and in steady employment. Only when an increase of wages is so excessive as to throw the balance of the entity out of gear, must it resist. But in the same sense, it cannot pay its stockholders in dividends a sum that endangers the security of the whole.

Militating against the bargaining potential of the stockholder is the fact that he is not bound to the corporation as is the employee. Owing to the difficulty of moving, plus the value of the pension, and seniority perquisites, the employee practically is forced to fight for his position on the home-grounds. Not so the small stockholder. He can sell out, and seek for greener fields. The stocks of the corporations with which we are dealing are listed on exchanges and easily saleable. It is a curious fact that with the growth of fixed or 'sunk' capital the small individual owner should have become more mobile than he was under conditions of free enterprise capitalism.

Management does have a vital interest in the contentment of its component parts. But there is no universal formula for arriving at a satisfactory solution of the problem of proportion to which each party is entitled. Management has no right to close the enterprise, for its function is to keep it going.

Either labor or stockholders have this right. Labor can refuse to work and under the law has the power to prevent others from working. Stockholders can close the doors, dismiss employees and liquidate as best they can. When both sides face such an undesirable solution to the controversy, a reasonable division of the product should be attainable. The necessary element of a bargain would be restored, for either party could decline to go further and decide to end the negotiations. A true bargain does not guaranty an agreement, but may result in a decision by either party *not* to cooperate, or buy, or sell. This element of necessity to arrive at an agreement deprives the management-labor conference of its true function of a bargain.

In view of the many ramifications that would result from stockholder-employee conferences, it might be asserted that this would be an unwise change. But the change has already taken place. Rather,

it is the legal concept that is out of step. When the interested parties are faced with the unalterable necessity of arriving at an arrangement, the elements of a bargain based on free enterprise competition cease to exist. Some other solution compatible with social welfare must be found.

There are many practical difficulties to the proposal for stockholder-labor bargains. (1) Stockholders have not developed a corps of expert representatives comparable to the representatives of labor. There is no fixed formula by which the division can be apportioned as between different enterprises, and different industries. It is not practical today to lower or raise wages as dividends can be increased or decreased or possibly passed. Even when the owner-manager was in full control, such shifts were difficult.

In the early thirties, I twice participated in administering a general wage cut. It was an agonizing performance, not less so because at the time it was essential to the health of the concern. Only the threatened obliteration of the industry, as in New England textiles — not the lowering of the rate of dividends — could justify a lower rate of wages. A turn in the business cycle would bring such problems to the fore.

(2) Another practical difficulty lies in the practice of industry-wide bargains. Closely related is the practice of individual company bargains that set a pattern which the industry must follow. This constitutes an interesting reversion to the wage-fund theory prevalent in the early nineteenth century. It takes no account of the ability of the individual company to meet the conditions imposed on it. The stockholder representatives would be in a weak position to bargain on such an industry-wide scale. Each unit of the industry being equally affected, a general price-level can be more easily imposed. But in this case the industry as a whole tends to lose its position in relation to other industries. Wage conferences have a complex of effects.

(3) Customers have asserted their interest in the division of the product. As regards their place in the corporate composite, an interesting recent novelty was the organized opposition of shippers to a request made by the Canadian Pacific RR before the Board of Transportation Commission for an increase in tariffs. It is not unthinkable that the customers of the U.S. Steel Corporation might have joined in the recent wage conference on the ground that an increase would result in higher prices to them. The customers of coal companies might well bring forward their interest in the price which might result from an increase of wages.

(4) In some cases, government has obtruded itself into the

so-called bargaining process. Government has shown its interest through the entrance of conciliators into the negotiations. Primarily to aid in a peaceful and just settlement, government has of late taken an active part in determining the rates of wages and prices. This intervention is ostensibly for assuring the continuous flow of goods so important to itself and to the public interest. It could not fail to recognize the breadth of concern over the atmosphere within which the industry operates.

(5) A fifth practical difficulty is in the formal recognition of the fact that management represents more than the interest of stockholders. Many persons would shrink from this. They would argue that no man can serve more than one master, despite the fact that this is the essence of management. Management could not, however, abrogate its function of managing. It would, indeed, call together the representatives of capital and labor, present the situation of the corporation as a whole, and attempt to guide the division of the product to a satisfactory conclusion. It is possible that this result could be more easily attained through the neutralization of management.

An influence which seems to be growing may operate in the form of stockholder resurgence. Several types of stockholders hold a significant number of shares. Investment companies, constituting a pool of many small owners, hold shares running into many thousands and aggregate a sizable percentage of total ownerships. Several universities hold large blocks. Recently, Harvard University as owner of 13,722 shares of American Gas & Electrical Company voted in the negative to a management proposal that cumulative voting for directors be adopted. Atlas Corporation has a policy of investing sufficiently heavily in a company to participate in its management. Newmont Corporation has a permanent and heavy interest in the success of several companies. Such large blocks of stockholding could develop into a nucleus around which small owners could rally to assert their claims.

The transition from one economic order to another is always accompanied by makeshift arrangements. Such arrangements are treated as exceptions, until they become so general that they are accepted as a new order. The structure of the economy has departed so far from the accepted legal theory that it is hammering out methods by which it can operate. Others beside stockholders and employees are dependent on the continuous flow of production.

The adverse effects of the recent steel strike were widespread. Other industries suffered. The national defense was delayed. Government lost necessary taxes. Consumers were hard hit, through shortages and higher prices.

Between them, the concept of the corporation as an individual and the immunity of the labor union from all regulation have created and can again create a situation bordering on chaos.

Nor can it be shown that these concepts are responsible for the dynamic techniques that have caused increased production. The balance between the disruption of progress and the orderliness of system has been thrown into jeopardy. The re-alignment of the economy is proceeding of its own momentum at a rapid pace.

It is interesting to speculate on the nature of the new order which is evolving. Already many individual steps have been taken which may point the way. Its characteristic is that it is unplanned, resulting from the ingenuity of many individuals facing a practical situation. This list is indicative, rather than exhaustive.

1. Prearranged division of earnings on a percentage basis between stockholders and employees.
2. Facilities for stock purchases by employees.
3. Division of stock ownership between management and employees which regulates the earnings of each.
4. Entrance by government into the machinery of wage negotiation.
5. The minimum wage by law and the imposition of a higher minimum on government contracts.
6. The election of a director to represent the public point of view.
7. The requirement that all directors be employees, in some instances supplemented by the voting rights of employees to the election of directors.
8. The wide range of pension systems which limit the freedom of movement of the individual and assure a security dependent on the permanence and success of the corporation.

The relationship of group interests to each other is in a fluid state. One can speculate on the nature of the changes that must take place before a new equilibrium is reached. One possible form of the future may be that the economy will develop into something analogous to feudalism, but based on industrial production instead of land.

Already management is firmly in the saddle. Already employees look to the corporation for security, through priorities, insurance and pension rights. Whether this attachment to the job is comparable to the attachment of the serf to land, it is a tremendous force to keep him where he is. Corporations make rules affecting the lives of employees with almost the binding effect of law. Vertical integration tends to increase freedom from outside pressure. A

strong cash position makes many corporations independent of banks.

But such developments follow no single or predestined pattern in a planless dynamic economy. They emerge through the pressure of events and the ingenuity of individuals.

NEW YORK

LOCATION AND DEVELOPMENT OF THE COTTON INDUSTRY

by R. Robson

1. *Introduction.*

'No conception can be understood except through its history.'

My object is to give an account of some of the fundamental trends in the development of the cotton industry and trade throughout the world. In its simplest terms certain locations have been found suitable for the growing of cotton and other or sometimes the same locations suitable for its manufacture. This has set up a trade both in raw cotton and in cotton goods which has been modified according to the natural growth of other centres of production and consumption or by Government intervention. In this paper I shall deal mainly with the second of these locational issues, that is with the circumstances leading to the establishment and development of cotton manufacturing industries and the resulting pattern of trade in cotton and cotton goods.

2. *Transport Costs as a factor in Location.* i. Although the actual circumstances attending the initial location of an industry are often largely of an accidental nature, there are always more general conditions which favour some districts rather than others, both in regard to the initial choice and to the subsequent expansion of the industry concerned. These more general conditions have been classified, for example, as natural advantages, that is amenities and easy access to power, markets and raw materials, comparative advantages in respect of competition for labour, land and capital, and acquired advantages, e.g. through the development of ancillary industries. I will myself follow the analogous but less general classification introduced by Weber,[1] who indicated primarily two regional factors of location: transportation costs and labour costs. The first of these would tend to locate industry at a point most convenient on the one hand for the supplying of its customers and on the other hand for access to the raw materials (including power), necessary to make the products concerned. In general these two conditions do not point to the same location. The first, in order to reduce transportation costs, would tend to locate industry near the great centres of population, the second near the centres of raw materials and power. Since there are obviously several of these centres, the tendency is for

[1] Alfred Weber, *Theory of Location of Industries.*

industry in the first place to be located at the point of minimum transportation cost in relation to all the elements, i.e. materials and finished goods which are transportable or have to be transported. The second factor (labour costs) is regarded as capable of exercising an attracting power away from the point of minimum transportation cost towards a region where labour costs are lower. Further deviations may be caused by 'agglomerating factors', i.e. by the acquired advantages already referred to, including the availability of banking, insurance and marketing facilities, or conversely by the 'deglomerative' factors, e.g. high rents and cost of living generally in congested areas.

ii. The transportable elements in the manufacture of cotton goods and their importance in the cost structure can be seen from Table 1, (p. 101), which in fact is a costing based on U.K. conditions in 1951. The most important item, accounting at that time for nearly half the grey cloth cost, is raw cotton. Raw cotton after it has been ginned is almost a 'pure' material in the sense of Weber, i.e. in that very little weight is lost in the process of manufacture. From the point of view of the weight to be transported,[1] therefore, there can only be a slight advantage if any in processing cotton at the point where it is grown rather than at the point where it is consumed as finished goods, since in the one case the finished goods must be transported and in the other the raw cotton. This is not so, of course, with seed cotton, where about two-thirds weight is lost in the ginning process[2] and therefore it is almost a universal practice to locate ginning factories at the point of cotton production rather than at the point of cotton consumption.

Let us now examine more closely the transport relations in regard to raw cotton and cotton goods. The most favourable relation is where the area of production of raw cotton and the area of consumption of the finished goods is the same, since in these circumstances local mills have normally an advantage in transport costs over outside mills both in regard to the transport of raw cotton and that of the finished goods. Such favourable areas are, however, limited in many ways. The quantity of cotton goods consumed in them is a relatively small part of world cotton goods consumption, since such areas exclude not only all those countries where cotton growing is climatically impracticable but also those parts of cotton growing countries where it is not grown either for climatic reasons or because of competition from other crops. Thus in the U.S.A., for example, cotton is only grown (except to a negligible extent) in 13 out of 48 States, i.e.

[1] Weight is not, however, the only factor to be considered, see p. 103.

[2] The seed has also to be transported but not to the same place as the ginned cotton.

TABLE 1

COST OF PRODUCTION OF MEDIUM WEIGHT COTTON GOODS IN THE U.K. IN 1951
(COTTON AT 40d.)

SPINNING

36's counts. Single Shift. High Draft. New Mill. 45 hour week
(50,000 spindles, 160 operatives, 45,000 lb./week)

		£ per week	d./lb.
1.	Raw Cotton	8,300	44.5
2.	Expenses. Power and Heating	380	2.0
	Other (Welfare, Insurance etc.)	210	1.1
3.	Wages	990	5.3
	Salaries	200	1.1
4.	Capital Charges		
	Machinery Cost. £500,000. Depreciation @ 10%	1,000	5.3
	Buildings Cost. £250,000. ,, @ 2%	100	0.5
	Interest @ 10%	1,300	8.0
	Working Capital	200	1.1
	TOTAL	12,880	68.9

WEAVING

70 × 70, 36/36, Single Shift, Automatic Looms, New Mill. 45 hour week
(1,000 looms, 150 operatives, 180,000 yds./week)

		£ per week	d./yd.
1.	Expenses. Power and Heating	380	.51
	Other	200	.27
2.	Wages and Salaries	1,400	1.87
3.	Capital Charges		
	Machinery Cost. £670,000. Depreciation @ 10%	1,340	1.79
	Buildings Cost. £200,000. ,, @ 2%	80	.11
	Interest @ 10%	1,740	2.32
	Working Capital	200	.27
	TOTAL	5,340	7.14

SPINNING AND WEAVING[1]

	Single Shift		*Double Shift* (37½ hours)[2]	
	d./yd.	d./lb.	d./yd.	d./lb.
Raw Cotton	8.0	44.5	8.0	44.5
Power & Heating	.9	4.8	.8	4.5
Other Expenses	.5	2.5	.5	2.5
Wages & Salaries	3.1	16.7	3.7	19.8
Capital Charges	7.2	39.6	5.3	29.2
TOTAL	19.7	108.1	18.3	100.5

FINISHING

Single Shift. 45 Hours. Dyeing. 1 million yds./week. 650 operatives

		£ per week	d./yd.
1.	Expenses. Power and Heating	1,500	0.36
	Dyes	2,000	0.48
	Other Chemicals & Materials	2,000	0.48
	Water	350	0.08
	Other: Insurance etc.	900	0.22
2.	Wages and Salaries	6,500	1.56
3.	Capital Charges		
	Machinery Cost. £630,000. Depreciation @ 10%	1,260	0.30
	Buildings Cost. £300,000. ,, @ 2%	120	0.03
	Interest @ 10%	1,860	0.45
	TOTAL	16,490	3.96

[1] Spinning and weaving costs combined at the rate, after allowing for waste and shrinkage, of 0.18 lb. per yd. or 37,000 spindles to 1,000 looms and excluding winding and beaming.

[2] For Double shift working assume: (1) Power proportional to increased hours, heating fixed.
(2) Expenses such as Insurance doubled, others proportionate to hours.
(3) Wages doubled, mill staff Joubled.
(4) Depreciation half as much again.

in an area accounting for less than one-third of the population (and therefore of cotton goods consumption of the country). Similarly in India, although there is a very wide distribution of cotton growing, such important centres of consumption as Bombay City and Calcutta are fairly remote from the cotton areas and in general of course the distribution of population by states is very different from that of raw cotton production; in particular Bengal,[4] Assam and the adjacent part of Bihar and Orissa are seriously deficient in the supply of raw cotton.

Moreover the cotton manufacturing industry is usually more strongly localized than that of cotton growing, so that the transport advantage in regard to raw cotton does not persist equally over the whole cotton growing area. Thus in the U.S.A. the Southern cotton mills are located in the Eastern part of the cotton belt and draw as far as possible[5] on the surrounding territory, since by doing so they save to varying extents on transport charges and sometimes on assembly and baling charges. These charges increase, however, on cotton from the central belt and the west, and so cotton from these areas tends to be shipped abroad since the ocean rates from the ports along the Gulf of Mexico begin to approach nearer to the rail rates to domestic mill centres.[6]

The transport advantage offered by locally grown cotton may also be modified in favour of the more distant but organized assembling market because of the wider selection of cottons which this market offers and because of the regularity and reliability of its supply throughout the year. In its more extreme forms this is illustrated by the import of long staple cotton from Egypt into the U.S.A. and the import of medium staple cotton from the U.S.A. into India. In neither of these cases would the local mills otherwise be able to meet the demand for finer cloths. More generally, although in India, with the exception of the Bombay City mills and the weaving mills of Bengal, cotton mills and especially spinning mills are almost invariably located in the cotton growing tracts, this limits their output very much, so that mills in the Central Provinces rarely spin above 20's and those in the United Provinces rarely above 12's otherwise they incur formidable rail transport charges on raw cotton.

Conversely the cotton grown in Egypt, the Sudan, East Africa and

[4] The deficiency in Bengal is associated with the decline of the hand-spinning industry in this area.

[5] North and South Carolina mills which account for nearly half U.S. cotton consumption consume more than three times the cotton produced in these states.

[6] Freight rates to Carolina mills fall from 0.97d./lb. on Texas cotton to 0.73d. on Tennessee cotton, and while there will always be some charge it must tend to get very small for Carolina cotton in the immediate vicinity of the mill. Similarly assembly and compression charges fall from 0.70d. to 0.60d. and in extreme cases of local supply may virtually disappear. Corresponding F.O.B. charges are in total 1.53d. and 1.33d. respectively. For Freight and Insurance to Liverpool add 1.21d./lb.

the West Indies in particular is of too high a quality to be used economically[7] otherwise than for a small part of consumer requirements in those territories.

Apart from facilitating a wider range of output and continuity of supply the choice of a wide range of staples is necessary to achieve the great economy of blending. Ideally, different kinds and qualities of cotton may be blended so as to manufacture a yarn of as good quality as that which can be spun from the best component of the mixture. Thus a typical mixing in Japanese mills for count No. 10 would be half S.L.M. American $\frac{7}{8}$ in. and half Bengal $\frac{1}{2}$ in. which at present prices would be one third or perhaps 1s. a lb. cheaper than a mixing based only on American. Such considerations tend either to minimize the price advantage which mills in the cotton growing areas derive from their access to raw cotton or to limit the range of qualities which they are able to offer.

The advantage which local mills have in regard to the transport of finished goods is more important since the incidence of these charges on finished goods[8] is much greater. Not only is it the practice for freight rates per lb. on cotton goods to be much higher than on raw cotton but in addition packing and insurance charges are much heavier as also are handling costs at every point (see Table 2, p. 104). The protection which local mills derive in this way obviously depends on the type of goods concerned and on the distances involved. It may range from less than 2 per cent on light weight cloths transported by sea to over 10 per cent on heavy cloths transported over distances which include a long rail travel (Table 2). The additional protection derived from access to locally grown cotton ranges in similar circumstances only from about 0.7 per cent to 2 per cent.

The advantage of proximity is, moreover, not only that of saving transport costs. Great advantage may be secured where it is necessary to keep closely in touch with the market either for the sale of the finished product or for the purchase of raw materials. This advantage is not merely one of time-saving.

[7] The bulk of Uganda cotton and the shorter stapled Egyptian cotton is of sufficiently high quality to be spun into yarn in the 40's to 60's range and Nigerian cotton into yarn in the 30's and 40's range, while the bulk of consumer requirements in these territories consists of cloth woven from coarser yarn of 24's counts and below, for the spinning of which a much cheaper cotton would suffice. In fact on Lancashire practice and on the basis of 1950-51 discounts and premiums for grade and staple, the quality of cotton used to spin 20's counts would be about 3d. per lb. cheaper than that used to spin 40's counts. Some allowance should be made, however, in this calculation for the fact that the higher cost of using a better quality cotton may be off-set by the better quality of the yarn produced and by the better spinning output obtainable; in particular, mills using indifferent labour might with advantage use high quality cotton.

[8] Cf. Hoover, *The Location of Economic Activity*: 'orientation to market may be based either on a weight gain in the process or on higher transfer cost per ton-mile on product than on material.'

TABLE 2

SOME TRANSPORT RELATIONS

1. Variations in incidence of sea transport with type of cloth. C.I.F. charges Manchester—Indian Port.

	Light Weight Cloths (Organdies, Voiles, etc.)	*Medium Weight Cloths (Cambrics, Sateens)*	*Heavy Cloths (Furnishing Fabrics)*
	..... *d./sq. yd.*		
Freight	0.44	0.59	1.20
Insurance	0.24	0.21	0.46
Cases (tin lined)* ...	0.49	0.52	0.67
Rail	0.02	0.04	0.07
TOTAL ...	1.19	1.36	2.40
Sq. yds. per 40 cu. ft. ...	7,000	5,000	2,300
Sq. yds./lb. ...	11.4	4.2	2.7
Price loco M/c. d./lb. ...	440	140	180

*for baling 0.28d. for medium cloths.

2. Variation in incidence of transport charges on Raw Cotton, Cloth & Machinery Manchester—Indian Port—Up Country

	Value of goods in d. per lb. loco M/c.	*F.O.B. Charges Liverpool*		*Freight and Insurance to Indian Port*		*Handling at Port and Transporting Up Country*		*Total Charges*	
		d./lb.	*As % Cost M/c.*	*d./lb.*	*As % Cost M/c.*	*d./lb.*	*As % Cost M/c.*	*d./lb.*	*As % Cost M/c.*
Medium Weight Cotton Cloth ...	140	2.5	1.8	3.4	2.5	4.4	3.1	10.3	7.4
Raw Cotton ...	25	0.15	0.6	1.40	5.6	1.45	6.0	3.0	12.2
Ring Frame ...	2	0.2	9.0	0.1	5.2	0.3	16.2*	0.6	30.4

*of which 12% handling charges.

These advantages are substantially offset on the one hand or enhanced on the other according to the size of the centre of consumption in which the mills are located. If it is large then local mills may be able to secure the necessary economies of production and distribution in catering for the centre alone and, in addition, have access to those factors of labour, capital and organization which large cities provide. If it is small these economies do not arise and the transport advantage may be insufficient to offset other advantages possessed by more distant mills. The attracting power of a city may also be diminished in so far as it is not a centre of consumption for cotton goods as textiles, i.e. because it offers few industrial uses for textiles or has a relatively small garment making industry.

Turning now to other possibilities, mills located in the centre of consumption but not in cotton growing areas are at an advantage since in general such mills have only to bear the cost of transport of raw cotton while outside mills have to bear the higher charges for transport of finished goods already referred to.

The least favourable transport relations will tend to exist for mills not located in cotton growing areas and engaged not in supplying a local market but the 'export' market, since they bear both the cost of

transporting the raw material and also of the finished product. These charges may be reduced when the mills concerned have specially good access to sea transport, and the 'export' trade tends therefore to be conducted by such mills. The U.K. cotton industry, for example, incurs (for the vast majority of the mills) costs of only 0.14d./lb. in transporting cotton from Liverpool to the mills and of about 0.20d./lb. in transporting the finished goods back again. Corresponding charges for the Italian cotton industry (Genoa-Milan) are at twice this level and for the Southern mill industry in the U.S.A. at about six times. In particular the lower internal transport charges in the U.K.[9] probably offset as far as the export trade is concerned the advantage which the Southern U.S. mills have in access to raw cotton.

iii. The remaining items shown in Table 1 are entirely consumed in the process of manufacture, and therefore any transport costs involved in bringing them to the place of manufacture are a net addition to the cost of manufacture. The first of these is power and historically this meant water power. As it was impossible to transport this, industry was originally located on streams where water power was available, and later, when coal became the source of power, the heavy cost of transport tended to locate industry where coal was available or easily accessible. Accessibility in this connection implies sea transport, since the great weight of coal in relation to its value means that transport charges may form a high percentage of its cost.[10] Thus, for example, the development of the cotton industry in Bengal has been assisted by the proximity of coal fields, in spite of the absence of locally grown cotton, while exactly the reverse is true of the industry in the Punjab.

The locating influence of coal has been seriously diminished, however, by the development of electricity and by the considerably increased energy yield brought about by changes in fuel burning equipment. The use of electricity by its ease of transmission has in

[9] The advantage of the location and concentration of the U.K. industry as far as transport charges are concerned is indicated by the Manchester-Liverpool freight rate on cotton goods which averages 0.2d./lb. Similar rates presumably reflect the level of internal charges, e.g. from mill to finishing works. Corresponding transport charges in the U.S. are perhaps represented by the rate of 1.3d./lb. on cotton goods from Carolina mills to New Orleans (and 0.8d./lb. on raw cotton in the reverse direction) Alternatively goods may be freighted to the New York-New Jersey area for finishing – this must take place on a substantial scale since for example (in 1947), 44 per cent of the cloth production of the U.S. is in the Carolinas but only 17 per cent of the finishing output while the New York-New Jersey and New England areas are the main finishing centres and then shipped from New York. Ocean freights on cotton goods are for example Liverpool-Karachi 2.4d./lb.; New Orleans or New York-Karachi 4.3d./lb.

[10] At present U.K. rail rates for a haul of 50 miles average about 18s. per ton or about 30 per cent of value. Transport from U.K. to inland Continental centres such as Milan would just about double the price of coal and so add about 5d. per lb. or 1d. per yard on medium cloth, to costs of production, hence the importance of hydro-electric power to the Italian cotton industry.

the case of hydro-electric schemes made water power transportable[11] and has extended the influence of other fuel resources. On the one hand, therefore, existing favourable locations from the point of view of access to power have become more widely spread, while on the other hand entirely new favourable locations have emerged. Thus, for example, the extraordinary development of the spinning industry in the Coimbatore district of India may be largely attributed to the completion of the Pykara hydro-electric project; while the industry in the Southern United States has been greatly assisted by the Tennessee Valley Authority.[12]

These differences are even more marked over the wider international field and tend to favour developed countries as opposed to undeveloped areas.

iv. Except in the finishing industry where water and chemicals are important, other materials used in the industry come mainly under the heading of accessories and repairs and may be considered as part of the original investment. In general, and with the obvious exception of water, transport may be regarded as adding an extra percentage to these costs, depending on the weight per unit of value, and this addition becomes significant for heavy materials and in undeveloped areas with unfavourable transport relations.

Water is an essential but has usually been made available at cheap rates so that it is only in the finishing industry, where large quantities are required, that cost becomes important. In spite of the cheap rates for public supply, averaging in this country about 1s. per 1,000 gallons, the charge amounts to about $\frac{1}{16}$d. per yard for cotton goods and $\frac{1}{4}$d. per yard for rayons, and in many parts of the world the rate is much higher, e.g. 2s. 6d. per 1,000 gallons in Gatooma (S. Rhodesia) where an industry is now being developed. In the absence of cheap public supplies, access to local supplies has been a strong localizing factor, but as in the case of electricity this factor is tending to become less important and on the whole to favour the large centres of population.

v. The last and easily the most important item shown under costs in Table 1 is interest and depreciation. Transport enters into these charges in so far as it puts up the cost of the initial expenditure on plant and also the cost of repairs. In the costs shown I have taken a ten years,[13] single shift basis for depreciation, which is rather high, but on the other hand I have made no separate allowance for repairs

[11] e.g. The Swiss and Italian mills were originally driven direct by water turbines and later by electric drive.

[12] Saving perhaps 1$\frac{1}{2}$d. per lb. on power charges in the manufacture of cotton cloth.

[13] Different rates should in practice be applied to different climates or alternatively we should assume that air conditioning is more necessary in some climates than others.

and renewals which may therefore be taken to be included in depreciation charges and influenced by transport to the same extent as the initial expenditure on plant. The addition for transport charges alone to these costs might be as much as 25 per cent to 30 per cent to inland locations (see Table 2), thus adding 10d. per lb. or 2d. per yard on medium weight cloth to costs of production.

The transport cost does not, of course, by any means represent the only extra cost incurred in erecting mills in centres remote from textile engineering services. Installation charges will normally add about 10 per cent. It is also necessary in addition to hold larger stocks of materials and replacement parts thus adding to interest charges and it is usually desirable to set up a small shop and foundry for minor repairs. More general disadvantages are referred to later.

3. *Labour Costs as a factor in Location.* i. Labour costs are of importance in determining the location of industry,[14] since labour is a relatively non-transportable item,[15] especially across national frontiers.

The cotton industry must offer wages high enough to attract labour from other industries, and historically this was achieved largely at the expense of agriculture and the domestic industry through the increases in output per head brought about by the early mechanical inventions. At this stage of development of the cotton industry, tremendous increases in productivity were achieved by means of a few ingenious engines based essentially on mechanical modifications to existing hand spinning and weaving machines and by the application of power. Thus the change from hand spinning to low draft mechanical spinning increased productivity 200 fold; that from hand weaving to power weaving 50 fold. These increases were matched on the raw material side by the use of power for mechanical ginning which in the case of roller ginning increased productivity 50 fold, while the subsequent invention of the saw gin raised it to perhaps 1,000 fold.

These increases in productivity were achieved at a gradually

[14] The usual view is that since wages form a higher proportion of total costs in the cotton industry than in industry generally there is a tendency for the industry to shift to low wage areas, e.g. Alderfer and Michl, *Economics of American Industry*, p. 305. The calculations on which such statements are based refer, however, to manufacturing industry only; agriculture and the extractive industries introduce other considerations. It is also very difficult to take account of the significance of locally available raw material in making such calculations, and in fact it is very difficult to give precision to the conception of 'wages cost' in an 'industry' as a percentage of the 'value of the product' purely for reasons of definition. Even granting all this the 'cotton industry' percentage is much lower than that of the 'iron' or 'aeroplane' industries.

[15] The differences in wage rates which can persist may be illustrated in the cotton industry by the fact that current hourly wage rates in the U.K. industry are about three times the rate in Japan but only one-third the U.S. rate.

increasing capital cost. At today's prices the capital investment per operative on a new mill single shift basis would be about £4,000 for low draft spinning and the corresponding capital charge about twice the wages charge. At this relation between capital and labour charges it is obviously desirable to consider double shift working, which normally reduces capital charges to a higher extent than it raises labour charges.[16]

ii. It is also obviously desirable to consider very carefully before embarking upon still more highly-capitalized methods of production. For example, the installation of automatic looms nearly trebles the capital outlay per operative in weaving.[17] Similarly, short processing in spinning, in so far as it involves also slower processing,[18] is a more highly capitalized method. The extent to which such methods pay depends on the level of wages and therefore the position varies from country to country. In India, where wages are low and where the hand spinner-weaver saves not only the high capital investment but also all transport and distribution charges, the transition to mechanical methods is a doubtful one.[19] On the other hand, if such a transition is made it almost pays to go still further and adopt the still more expensive[20] automatic machinery, since by so doing the skilled attention of the operative is largely obviated.

In the U.S.A. the cotton industry has to pay high wages in order to attract labour from agriculture and therefore a highly capitalized method of production is necessary[21] and this is rendered economic by the protective tariff.

It is in fact scarcely an undue simplification of the wages problem to regard agriculture as the main alternative occupation determining the level of wages in most countries. In those countries such as the U.S.A., Canada or Australia where population is small in relation to resources, the tendency is for the cotton industry and for manufacturing industry generally to be heavily protected in order to attract the necessary labour from agriculture. In eastern countries, on the other hand, population pressure has reduced the standard of living to be derived from agriculture so much that they tend to

[16] On U.K. double shift practice capital charges are reduced by about 30 per cent per unit of output and labour charges increased by about 20 per cent (Table 1).

[17] Table 1. At present prices nearly £6,000 per operative on a single shift basis against £2,000 for ordinary looms.

[18] Or alternatively perhaps the use of better quality cotton.

[19] In the case of weaving where the increase in productivity is much less than in spinning the transition from hand weaving is particularly slow, thus in India there are still 3 million hand looms accounting for about one-quarter of cloth production.

[20] Especially if taxation operates in favour of expensive equipment.

[21] The number of spindles per mill operative on U.K. low draft practice (36's counts) averages about 260, on U.K. high draft practice about 320 and on U.S. practice about 520. Similarly the number of automatic looms per mill operative on U.S. practice is usually about twice that in the U.K.

become low-wage competitors in any manufacturing industry which can be established.[22] It remains a debatable point whether the deliberate encouragement of manufacturing industry in such countries can reverse this process.[23]

4. *Acquired advantages as a factor in Location.* One of the main advantages which a developed industry can acquire has already been referred to, namely, the creation of ancillary industries. These include not only, in the case of the cotton industry, the textile machinery industry with its facility for replacing, renewing and repairing plant, but also the specialized firms dealing in mill supplies such as card clothing, driving ropes, shuttles, etc.

Some aspects of the advantages so derived are measurable, and their extent has been indicated by reference to those cases where this advantage does not exist. Thus transport cost to remote countries may add so much to the cost of installation of machinery that costs of production may be raised by 15-20 per cent as a result of the higher capital investment required. Similarly, we may estimate the effects on cost of production of the higher charges involved in holding larger stocks of materials and machine parts in remote countries or in transporting intermediate products between the component parts of a widely-scattered industry. Many aspects, however, and perhaps the more important ones, cannot be so measured. Thus the general effect on mill efficiency of the development of a textile machinery industry alongside a textile industry can scarcely be measured, nor, more generally, of such services as banking and insurance, nor, more

[22] Especially when no special skill is involved and when other elements in the cost structure are favourable, as in goods made from locally grown cotton or with a high labour content. In general these are coarse goods, since capital per operative decreases on coarser goods, but also all cloths with low added value per unit of labour, either because of low capital equipment, e.g. plain looms, or because they are more easily and quickly made.

[23] Cf. the United Nations report, *Measures for the Economic Development of Under-developed Countries*. The main point at issue is whether industrialization will help to raise the standard of living by taking people off the land or whether this will be dissipated in population growth, e.g. pp. 8-9 'Under-employment in agriculture arises mainly out of the limited supply of land available to the average farming unit . . . the main remedy is to create new employment opportunities. Where more land can be brought into cultivation this will afford some relief. But in most countries where under-employment is prevalent nearly all the cultivatable land is already cultivated. Effort has then to be concentrated upon creating new industries off the land, of which manufacturing industries comprise the largest and usually the most promising category.'

Similarly Hoover, op. cit., p. 190: 'only in a somewhat industrialized region it seems is the population sufficiently urbanized to emancipate it from the vicious Malthusian circle of population growth and pressure'.

Personally I should have thought the example of Denmark on the one hand or Japan on the other sufficient to discredit this view of industrialization. In contrast compare Jewkes, *Growth of World Industry*: 'The association of high industrialization and high income may not be direct cause and effect, the industry and the opulence can perhaps be ascribed to a common cause – the natural ability of the people and the occurrence of natural resources.'

generally still, that of a constantly developing science and technology.[24]

Similarly, it is probably impossible to measure the advantages of the specialization of activities within the industry, e.g. into raw cotton buying, spinning, weaving, processing and converting, etc. The extent of the economies achieved in this way by permitting specialization of managerial abilities,[25] of types of output and of operative skill can scarcely be measured but must be considerable, for in the outstanding example of such specialization, i.e. the Lancashire cotton industry, it was proved impossible in general for the integrated firm to exist in competition with the specialized one.

Great advantages are derived, moreover, purely from the concentration of industry itself. Industries become linked by their complementary use of labour,[26] or of materials or of services, while the volume of business alone brings in its own economies.[27]

5. *The Regional Location of the Cotton Industry.* i. The locational factor of transport costs naturally tends to exercise a greater influence the greater the distance over which it operates. In countries where great distances are involved and transport facilities relatively undeveloped, one would expect the cotton industry to be located in several centres since no one centre could be expected to be most favourably situated in respect to all centres of consumption and all sources of materials, and in particular access to power and the

[24] The advantage of industrial expansion generally is described by Jewkes, op. cit.: 'The increasing size of the system as a whole brings a double advantage; it renders possible bigger factories and bigger firms and it opens up the way to greater specialization. Specialization lowers cost, widens the market and creates scope for more specialization. Expanding profits create a widened source of profits, which can be ploughed back. The rising standard of living makes voluntary saving easier. Scientific interest branches out increasingly into technology and towards economic objects. Each new invention opens up a wider range of technical exploitation of the work of the scientist.'

[25] The variations in costs due to variations in managerial ability are so great that it is reasonable to suppose that great economies are realized by an industry which is so specialized as to afford the maximum opportunity for different types of managerial ability to be deployed and developed.

[26] e.g. Chapman, *The Lancashire Cotton Industry*, p. 157: 'Of course the machine works were planted in Oldham largely because of the presence of the cotton industry, but if there were no machine works the nature of the demand for labour in Oldham would make it a less desirable town for the operatives, other things being equal. The mills and the machine works together with other industries attract particular kinds of labour to Oldham; and these classes of labour afford about the right proportion of men, women and children to meet the industrial needs of the town. The industries attract labour in families and the more or less surplus members of the families attract other industries.'

[27] e.g. Hoover, op. cit., p. 119: 'On the organized transfer network are certain strategically located transfer "nodes" with special locational advantages as procurement and distribution points and therefore as processing centres for all kinds of activities in which transfer costs are locationally important. There is only a limited number of such nodal points and each is a production centre for manufacturing as well as for trading and intermediate handling operations. Since the transfer advantages of these points rest partly on large-volume traffic and frequent and flexible service, there is evidently a cumulative pressure towards concentration of transfer advantage.'

combination of locally grown cotton and local markets are strong localizing factors. In small countries with relatively highly developed transport facilities one centre might develop under the influence of the third factor of acquired advantages. These varying circumstances may be illustrated by comparing the history of the location of the cotton industry in such widely different countries as the U.K., U.S.A., and India.

ii. The U.K. cotton industry has seen several changes in location. In its first phase as a domestic industry prior to the great mechanical inventions of the late eighteenth century it was located mainly in Lancashire which, besides the general advantage of an already established linen and woollen industry had the particular advantage of freedom from contemporary regulations on industry and trade.

The next phase followed the introduction of mechanical spinning 1760-80, the effect of which was to force spinning, as a separate industry, into power driven factories, leaving weaving to be carried on separately as a domestic industry. At this stage power was derived from water and was therefore a powerful locating factor. Spinning mills were set up all over the country wherever water power was available, and for a time Lancashire became relatively less important as a centre of cotton manufacture. In particular Scotland, where there were similar conditions in regard to port facilities, water supply and a merchanting organization, became important.

This decentralization was apparently checked after the steam engine came into general use from 1800 onwards and tended to concentrate factories into areas such as Lancashire where coal and water suitable for engines were to be found, together with, of course, access to the sea. Lancashire was not the only area with these advantages, but taken in conjunction with the already established marketing facilities and the rapid technical development of the time, which was certainly centred in Lancashire, they were sufficient gradually to pull the cotton industry into this area, a process which accelerated as the advantages of concentration became more apparent. In 1780-90 rather less than one-third of the cotton mills were in Lancashire, but by 1835 the proportion had increased to over one-half and the Lancashire mills were almost all modern, i.e. steam driven. By the end of the century the present concentration of the industry was virtually established; 76 per cent of the operatives employed were in Lancashire, compared with 59 per cent in 1835, while the proportion in Scotland fell from 14 to 6 per cent, in Cheshire from 14 to 7 per cent, and in Derbyshire from 4 to 2 percent.

The establishment of Liverpool as the leading port for imports of cotton took place much earlier. As late as 1789 London stood first

with an import of 48,000 bales against 47,000 received at Liverpool, but by 1795 Liverpool had taken the lead and by 1835 nearly 90 per cent of cotton imports came through Liverpool. The yarn and cloth exchange in Manchester was also established very early so that the markets necessary for the specialization of businesses existed.

While this heavy localization of the industry was taking place two other associated developments also occurred. First, a geographical separation of spinning from weaving. In 1841 the position in Lancashire was that about 69,000 operatives were in mills engaged in spinning only, and only about one-quarter of these were north of Rochdale; about 109,000 were employed in mills engaged in both spinning and weaving and these were fairly widely distributed over the county, while only about 8000 were employed in mills engaged in power weaving only and these tended to be mainly north of Rochdale. Such independent weaving concerns developed rapidly, however, during the next twenty years in the north of Lancashire, where labour was in fact plentiful owing to the replacement of the hand loom weavers, while independent spinning remained in the south, where amongst other factors close contact with the Liverpool cotton market was essential. By the 1880s 78 per cent of the spindles were in the south and 62 per cent of the looms in the area north of Rochdale; by 1937 the proportion had grown to 90 per cent and 75 per cent respectively.

Secondly, there occurred the specialization by process into spinning and weaving. The proportion of operatives employed in the combined spinning and weaving units decreased gradually from about 58 per cent in 1841 to 50 per cent in the 1880s and then more rapidly from 1904 onwards, following the establishment of the great spinning mills in the south, to less than one quarter. A further liquidation of such units during the depression of the 1930s reduced the proportion to about 10 per cent.

The Lancashire cotton industry with its specialization of businesses is perhaps the outstanding example of how acquired advantages can retain an industry in one location long after other advantages of the location have largely disappeared, and even withstand such direct attacks as the closing of the Liverpool cotton market and the deliberate attraction of new industries. So far the extent of decentralization has been slight. Taking the broader definition of the Lancashire area to include the adjacent districts of Glossop, Skipton and Hebden Bridge, the proportion of operatives employed in the spinning industry outside the area in 1939 was 3.1 per cent and is now 3.5 per cent. The increase in the outside proportion is the result of a contraction in the Halifax area and a slight increase

in Scotland, together with the establishment of two new mills in Northern Ireland. This change is very slight but it is significant that the only post-war spinning mills have been erected outside Lancashire. The mills in these outside areas are illustrations of the general principles that they serve local markets or export, or have been attracted by special facilities. In cotton and rayon weaving in 1939, 8.7 per cent of operatives were outside the Lancashire area. The proportion now, even if we exclude the weaving of long staple rayon in Northern Ireland and Scotland as being a substitute for flax, has risen to 12.4 per cent.

iii. The development of the mill industry in India must be considered with reference to the widespread domestic hand spinning and weaving industry with its superior access to raw cotton, and virtual independence of transport, power and capital charges. The mill industry in fact was established in Bombay expressly for the export trade in yarn and not for the home market. Capital was provided by the merchants of the port, and the port facilities also helped the import of textile machinery and stores on the one hand, and raw cotton supplies on the other hand, because of the export trade in cotton conducted from an early date. With the loss of the yarn market and the shift to the internal piece goods market, Bombay has had to face increasing competition from other centres, especially those such as Ahmedabad more favourably situated in regard to raw cotton supplies. In 1911 Bombay City Mills were responsible for 52 per cent of Indian yarn products and 55 per cent of cloth products, but in 1941 for only 26 per cent of yarn and 31 per cent cloth. With the separation of India from Pakistan, however, this trend has been reversed as India is now more dependent both on export of textiles and on imports of cotton than formerly, and so the Bombay mills are to this extent once more favoured in their location. As far as the internal market is concerned, however, and in fact since the development of railways from 1860 onwards, it has become increasingly practicable to establish mills in the interior of the country at centres favourably located both in regard to locally grown raw cotton and consumers markets, and to power supplies, and competing favourably with both the older centres and the domestic industry. The continued improvement in transport facilities, with which more recently may be associated as far as power is concerned the great hydro-electric schemes of Madras Province and the Punjab, is bringing about a dispersal of the cotton industry. No new mills have been established in the cities of Ahmedabad, Bombay, Delhi and Madras since 1933 and the general trend is fairly strong towards internal centres of consumption

and raw cotton growing which usually happen also to be low wage areas — wages in South India are in general only one-half to one-third of those in the traditional centres of the industry.

iv. As in the U.K., the U.S. cotton industry was initially located near sources of water power in New England, and experienced a minor shift in location when steam power came into use, but the classical territorial shift was that from the North to the Southern States. Up till the Civil War cotton growing was so profitable in the South that its manufacture was not considered. The Civil War and the plight of the white people after the Civil War convinced the South that her economy was too unbalanced and a deliberate effort was made to bring the cotton mills to the cotton fields. To this end practically all Southern States granted free lands for the construction of mills and relieved them of taxes (as many still do today), but the main attracting factor was undoubtedly the availability of cheap labour. Average hourly earnings in the cotton mills of the South were for many years only two-thirds of those in the North, and were still 20 per cent below in the years immediately preceding World War II.

The South has now over three-quarters of the industry and this is fairly strongly located in the East cotton belt. Proximity to raw cotton has some effect on output in the sense that the South still tends to concentrate more on the heavier fabrics, but as most of the centres of consumption (as far as the garment trade is concerned virtually all cutters are in New York) are remote from the South the transport advantage is only slight.

6. *Location and International Trade.* In this section I will endeavour to outline the main changes in location of the cotton industry internationally, and the corresponding trends in international trade in raw cotton and cotton goods, statistics covering the latter being given in Table 3.

i. The first change in location covers that period from 1750 to 1790 when the U.K. industry was developing the new mechanical inventions and was endeavouring to prevent their adoption by other countries. During this period U.K. cotton consumption, which had been fairly stationary under the domestic system at about 2 million lb. per annum during the preceding fifty years (1700-50), began to increase, reaching about 4 million lb. per annum in 1760, 7 million in 1776-80, and then increasing more rapidly to 25 million lb. per annum in 1790. It was round about this time that it is estimated to have overtaken cotton consumption on the Continent, which was still on the domestic system. In the U.S.A., where the

TABLE 3

ESTIMATED ANNUAL U.K., U.S. & WORLD CONSUMPTION AND TRADE IN COTTON AND COTTON GOODS

Million lb.

	1790	1829-31	1882-84	1910-13	1926-28	1936-38	1949-51
WORLD							
Mill Consumption of Cotton: Total ...	25	420	4,000	10,500	12,200	14,000	14,100
of which Imported	25	370	2,800	6,490	6,840	6,270	5,570
% Imported	100	88	70	62	56	45	40
Cotton Content of Cotton Goods Imported	5	230	1,500	2,970	2,860	2,220	1,950
as % production	25	55	38	28	24	16	13
				*(3,340)	(3,020)	(2,380)	
				(32)	(25)	(17)	
U.K.							
Mill Consumption of Cotton	25	240	1,480	2,100	1,470	1,320	1,000
As % of world mill consumption ...	100	57	37	20	12	9	7
Export of Cotton Goods (Cotton Content)		160	1,260	1,710	1,090	610	350
as % of World Trade	100	70	82	58	39	28	18(14)[1]
as % of Production	25	67	85	81	74	46	35(28)[1]
U.S.A.							
Mill Consumption of Cotton	—	50	890	2,400	3,300	3,300	4,340
Export of Cotton	—	280	1,900	4,520	4,390	2,420	2,430
As % of World Export of Cotton ...	—	78	68	68	61	38	43(35)[2]
U.S. Consumption of American Cotton as % of World Consumption of American Cotton	—	15	32	34	43	57	65

[1] Excluding cloth imported for processing and re-export.
[2] If we assume Season 1951-52 more representative of competitive conditions and that the 25% exports then financed through the Mutual Security Agency and the Export-Import Bank would not otherwise have been achieved.
* After allowing for changes in National frontiers.

NOTES

Figures relate to mill consumption of cotton only. The consumption of cotton in hand-spinning and other uses may be estimated (on the basis of population and consumption per head) to have amounted to 500 million lb. in 1790 and probably exceeded 1,000 million lb. by the 1880s. From then onwards it began to decline first as a result of the establishment of mills in India and later of mills in China, the two main hand-spinning countries. It probably does not exceed 400 million lb. today.

The cotton content of cotton goods entering into international trade is based prior to 1910-13 very largely on figures given by Ellison. From 1910 onwards more detailed statistics are available and the estimate is based on actual figures of the weight of yarn and cloth exported plus 20%. The addition of 20% reflects immediate pre-war practice in the U.K., where consumption other than yarn and piece goods accounted for 14% by weight of exports of cotton goods and 6% waste was entailed in the process of manufacture. In earlier years the somewhat lower proportion of exports other than yarn and piece goods appears to have been compensated for by a higher rate of waste, and this would also appear to be the case in other countries.

Raw cotton figures are averages of seasons; cotton goods figures averages of calendar years.

first mill was started in 1790, consumption was about 2 million lb. per annum.

The main locations of cotton consumption at that time, accounting perhaps for nine-tenths[21] of consumption, were still outside Europe in the cotton growing areas of the world, i.e. India, China, Brazil, Turkey and the Near East.

International trade consisted largely of importing raw cotton into European countries from their colonies, including Brazil, or from Turkey, and the bulk of the export trade in cotton goods was in exchange. U.S. cotton only began to arrive regularly from 1791 onwards and in volume after the invention of the saw gin in 1793-95; Indian cotton imports also started after this date.

[21] See Notes to Table 3, above.

ii. By the early 1830s the advantage which the U.K. derived from being first in the field with the mill system had achieved its maximum effect and mills were being rapidly installed in Europe and the U.S.A. under heavy protection. (This trend was later recognized in 1843 by the repeal of the prohibition on the export of textile machinery.) U.K. mill consumption of cotton by 1830 may have reached 57 per cent of total cotton consumption in the cotton mill countries of the world, but from then onwards began to decline relatively, although a very great absolute expansion continued until the first World War.

The protectionist policy adopted abroad up till this time was not sufficient, however, to check even the relative expansion in international trade in cotton goods. Apart from the substantial Colonial trade monopolized by France and Holland this was held almost entirely by the U.K. and went mainly to Europe and America. U.K. exports represented in 1830 about two-thirds of production (compared with one quarter in 1790) and perhaps 70 per cent of world trade. On the raw cotton side, the U.S.A. had by this time become the principal country in world trade, accounting for nearly 80 per cent of world exports of raw cotton.

iii. During the next fifty years the main changes in location were those caused by the relative decline in size of the U.K. industry compared with those in Europe and the U.S.A. (reducing the proportion of U.K. consumption by 1883 to 37 per cent compared with 57 per cent in 1830) and the development of a mill industry in the cotton growing areas of the world, first and mainly in Bombay, where the first mills were established in the 1850s, and later in Brazil and Japan.[**] Mill consumption outside Europe and U.S.A. by the early 1880s may have reached 5 per cent of the world total. The effect of this expansion of the mill industry was to bring about a decline in the relative growth of international trade in cotton goods, but with the notable exception of trade with the U.S.A., where severe protective measures had been introduced after the Civil War, the rapid increase in the absolute volume of international trade still continued. Imports into India were losing ground relatively to local mill production, while together they had reduced the hand spinning industry to less than one-third its former size.

The rapidly expanding volume of world trade in mill made cotton goods, which had now become really world-wide, was held to a still increasing extent by the U.K., whose share of world trade now exceeded 80 per cent and represented about 85 per cent of output.

On the raw cotton side, the U.S.A., after increasing her share of world trade to 80 per cent prior to the Civil War, lost ground as a

[**] Japan's imports of raw cotton exceeded production first in 1889.

result of the opportunity thus given to other suppliers and of the increased demands of the protected local industry which now took one-third of production compared with less than one-quarter prior to the Civil War. The gap was filled mainly by India, who increased her share of world trade to nearly 20 per cent and whose trade, as well as that of the European consuming industries, had been facilitated by the opening of the Suez Canal.

iv. From 1880 onwards the location of the cotton mill industry moved rapidly away from the traditional centres of Europe and the U.S.A., and by 1910-13 over 20 per cent of the industry was outside this area compared with only 5 per cent thirty years previously. At the same time the U.K. share of world consumption fell from 37 to 20 per cent.

World production of cotton goods increased two and one-half times during the period, while world trade in cotton goods doubled, the proportion of production destined for export trade falling from 38 per cent to 28 per cent.

U.K. exports of cotton goods continued their rapid absolute expansion but for the first time began to decline relatively in face of foreign competition. This competition came primarily from India and Japan[30] especially in the yarn trade in their respective markets and with China.

To a secondary extent it also came from Europe whose cotton industries had now acquired several advantages. Cotton exchanges had been established and already by the 1880s they had largely broken away from dependence on Liverpool, importing only 20 per cent of their supplies via the U.K. compared with 40 per cent only ten years previously. As previously mentioned, they also consistently made better use of cheap Indian cotton; during the peak period of 1882-84, 40 per cent of their cotton consumption was Indian compared with 10 per cent in the U.K. and in the 1910-13 period when Japan was taking most of the crop still 10 per cent compared with only 2 per cent in the U.K. A further significant change was brought about by the discovery and use of hydro-electric power, which led in particular to a rapid development of the Italian cotton industry. On the market side, the industries of Italy and Austro-Hungary were able to develop an increasing export trade with the adjacent territories of South-East Europe.

On the raw cotton side previous trends developed slowly, the U.S. share of world trade being maintained at 68 per cent while the U.S. industry consumed a slightly higher proportion, 34 per cent, of cotton produced.

[30] By 1900 Japan had become a net exporter of yarn and by 1910 of piece goods.

v. Previous trends were, however, considerably accelerated by World War I, which mainly involved the European countries and led therefore to a significant shift in location. By 1926-28 world consumption of cotton had increased by 16 per cent above its pre-war level but European consumption was unchanged, and U.K. consumption had declined by 30 per cent. Over one-third of the world's cotton industry was now outside the traditional centres of Europe and the U.S.A., and in particular over one-quarter was located in China, India and Japan. The development of the industry in China and India led to such a reduction in trade with these markets that for the first time the volume of world trade in cotton goods declined absolutely — previously it had shown only a relative decline. The combination of the contraction in total available trade and competition from Japan for what was available reduced U.K. exports to two-thirds of their pre-war volume and to 39 per cent of the world total. On the raw cotton side the U.S. consumed an increased proportion of her own crop (43 per cent cf. 34 per cent pre-war) and her share in the international raw cotton trade fell to 61 per cent (cf. 68 per cent).

vi. From 1928 to 1938 the cotton industry went through the general depression when tariffs were raised everywhere in an effort to protect local industries which accordingly expanded more rapidly than at any previous time. By 1936-38 over half the world s mill cotton consumption was outside the U.S. — Europe area, and although world consumption was then about 15 per cent above the 1926-28 level, world trade in cotton goods had declined by 20 per cent and amounted to only 15 per cent of world production. At the same time Japan doubled her exports of cotton goods raising her share of the available world volume to over one-third. The trend of world trade in cotton goods prior to World War II, was accordingly that of a fairly rapid decline in the total available and a rapid increase in the share of this diminished total taken by Japan.

The depression and the associated Japanese pressure in all markets led not only to the increase in tariffs but also to the erection or augmentation of preferential systems. All the Colonial powers established preferential systems in their own Colonies. In other markets bilateral agreements were entered into and there were very few markets where open competition between the cotton goods exporting countries prevailed. In the case of the United Kingdom industry it may be estimated that about three-quarters of cotton goods exports were protected in some way, but in spite of this exports fell to little over half of their pre-depression level and to 28 per cent of world trade.

On the raw cotton side the development of local industries in the cotton growing countries reduced the proportion of cotton entering into world trade to 45 per cent, and for the first time also produced a decline in the absolute volume. At the same time the previous trend of American cotton to become less competitive with that of other countries was encouraged by the price support schemes of the depression, and the U.S. proportion of world trade fell sharply from 60 to 38 per cent, losing especially to South American and African competition.

In spite of the crop of trade restrictions during this period an approach was nevertheless made to the solution of certain basic problems. The Ottawa Agreements embodied the principle of limiting the degree of protection accorded to newly established cotton industries to what was necessary for 'reasonable' competition, and the Anglo-Indian and India-Japan bilateral agreements introduced the idea of exchanging raw cotton for cotton goods, thus encouraging cotton growing vis-à-vis cotton manufacturing in this most important territory.

vii. The next phase takes us through the war and to the end of the Socialist Government in Britain in 1951. The reduction in supplies from the cotton goods exporting countries during this war, was much greater than in previous wars since exports from the Continent and Japan were entirely cut off from most of the world while exports from the U.K. were restricted as part of the war effort. In consequence a tremendous fillip was given to the development of cotton manufacturing in other parts of the world (e.g. in Latin America where output doubled), and world trade fell to 13 per cent of production. After the war ended this shortage still persisted, for on the one hand the Japan cotton industry had been reduced to only a quarter of its previous size and so took time to recover, while the U.K. industry recovered very slowly.

This weakness of the U.K. industry at a critical period in the history of the cotton industry is perhaps the most significant event in the post-war phase. It was due in the main to the inflationary policy of the Socialist Government, which was largely responsible on the one hand for the industry's failure to attract labour from other occupations (and was to some extent directly prevented from so doing on grounds of cost of living stabilization) and on the other hand for intensifying exchange difficulties with their effect on raw cotton purchases. The consequences were extremely serious. To the encouragement thus given to local industries in general was added in the case of the Dominions a further impetus from the weakening (as a result of the General Agreement on Tariffs and Trade) of

Imperial Preference, with its safeguards on uneconomic expansion. To this post-war era belongs, therefore, the rapid expansion of the cotton industry in Pakistan, Australia, South Africa and Southern Rhodesia.

The Pakistan case was a commercial tragedy for Lancashire. The separation of India into the Indian Union and Pakistan, the former containing virtually the entire cotton mill industry and the latter virtually no mill industry but the bulk of the raw cotton of interest to the U.K., presented Lancashire with a remarkable opportunity to widen her sources of raw material and expand her trade at one and the same time. For reasons which have never been properly understood the opportunity was missed; Pakistan started on a programme of rapidly expanding her mill industry, and the U.K. preference in what was potentially the greatest market in the world was reduced from 35 per cent to 5 per cent.

This was perhaps the major failure in post-war commercial policy, but over the whole field of commercial negotiations the cotton industry tended to be overlooked because of its inability to supply. It must also be recorded that there was some prejudice, e.g. in relation to the re-opening of the Liverpool market (although the speculative argument advanced was a pure misreading of history since the advent of the telegraph and hedging almost halved the handling charges involved in bringing cotton to this country) and in relation to the long term prospects of the industry.

Very different policies were pursued by our competitors. While the U.K. industry's share of world production fell from 9 per cent pre-war to 7 per cent and her exports from 28 per cent to 18 per cent, the Western European industry which started from a much less advantageous immediate post-war position increased its share of production from 17 per cent to 18 per cent and of trade from 25 per cent to 36 per cent.

On the raw cotton side the volume of world trade continued to decline in accordance with the long existing tendency for the cotton growing countries to develop their own manufacture. The proportion of locally grown cotton consumed in the U.S.A. increased from 57 per cent pre-war to 65 per cent, and in India from 56 per cent to 75 per cent, while in the latter case the actual production of cotton was itself much lower mainly because of the war-time diversion to food crops. Apart from these well established trends the post-war situation has been too unstable to detect whether the previous tendency for U.S. cotton to become steadily less competitive is still continuing and with what intensity. On the one hand the dollar shortage, itself largely an alternative to higher U.S. prices, has been

overcome by the operation of the Economic Co-operation Administration, the Mutual Security Agency, and the Export-Import Bank financing through loans or grants half U.S. sales of cotton in the 1950-51 season and one quarter in the 1951-52 season. At the same time the shortage of cotton during the 1950-51 season enabled the producing countries (other than the U.S.A. which adopted export quotas instead) to impose export duties.

These measures naturally reacted upon the international cotton goods trade, acting in favour of the industries of the raw cotton growing countries and against those dependent upon imported cotton; especially affected was the U.K. industry, historically the prime user of American cotton, against which the U.S. quotas were discriminatory, reducing imports to one-sixth of total imports from all sources.

viii. It is worth while to examine separately and more closely the decline in international trade in cotton goods which has been so characteristic of the developing world cotton industry. First of all, it is more severe than the figures so far given would suggest, since the break-up of such areas as Central Europe after the first World War, and of the Indian sub-continent into smaller states, has the effect of counting as international trade, trade which was previously inter-regional across the newly-created frontiers. The new centres of production and new distribution areas created by these frontiers soon bring about a reduction in international trade in cotton goods but have a much smaller effect on international trade in raw cotton since unless the new production centres are also cotton-growing centres the only effect is a redistribution of cotton imports; thus since 1910-13 world trade in raw cotton has declined only from 62 per cent of consumption to 40 per cent, while corresponding figures for cotton goods show a much steeper decline from 28 per cent to 13 per cent.

It is appropriate, therefore, to divide the countries of the world into cotton-growing and non-cotton-growing areas and follow the development of the industry in those two areas. The mill industry itself started in a non-cotton-growing country, but hand spinning started, of course, in the cotton-growing countries, so it is perhaps not correct to regard the development of the mill industry in the cotton-growing countries as something new. Subject to this qualification, however, the pattern of world trade until 1860 was a simple one. Cotton was imported for manufacture into Europe and the only cotton-growing area which was also manufacturing was the United States. The effective establishment of the mill industry in India in the 1860s was followed by Brazil and Mexico by the 1880s and by

Japan, at that time also a cotton-growing area, and China by the 1890s. From 1910 onwards the development of industry may be followed more closely, as in Table 4 (p. 123) where the various countries are combined into nine groups under the general heading of cotton-growing or non-cotton-growing areas.

The first group (Col. 1) of the non-cotton-growing countries consists of the cotton goods exporting countries, i.e. U.K., Western Europe and Japan, who import raw cotton and export cotton manufactures. The cotton consumption of this group has declined, partly owing to the decline in exports which in 1910-13 accounted for over 45 per cent of the production of the group but in 1949-51 for less than 30 per cent, and partly by the use of synthetic fibres which by 1949-51 amounted to 55 per cent of cotton consumption. There was also a steady decline in the import trade of this group until 1936-38 (after allowing for changes in frontiers; the uncorrected figures show an increase from 1910-13 to 1926-28 arising from trade within the separate parts of the Austro-Hungarian Empire). At this point imports amounted to about 6 per cent of home consumption and represented perhaps the volume of trade which might be expected to flow between fully-developed cotton industries on a novelty basis.

Group 2 consists of the principal markets for cotton goods outside the cotton-growing areas and includes the British Dominions, the non-cotton-growing colonies of Britain and France, Indonesia, Scandinavia, and the non-cotton-growing countries of Latin America. This group has developed an industry based on imported cotton especially during the recent war and post-war years, but has nevertheless so far maintained a slightly increasing import trade in cotton goods. In the British Dominions, the Ottawa agreements in the pre-war years tended to control uneconomic industrial development, while in the Scandinavian countries a balanced industrial development has always been consistently maintained.

Turning now to the cotton-growing areas of the world, the effect of locally-grown cotton on the development of an industry is immediately apparent. The only group where cotton goods imports have not been very heavily reduced is the Colonial countries. It has been shown that access to locally-grown cotton is of little economic significance as a locating factor but its political and psychological influence is great; several countries, e.g. Colombia, have initially based a cotton industry on the need to find a market for their cotton growing (and have subsequently turned into cotton-importing countries) while even Australia developed its cotton manufacturing industry on the argument that it was necessary to take up Queensland cotton.

TABLE 4

DEVELOPMENT OF THE COTTON INDUSTRY AND TRADE 1910-51

NON-COTTON GROWING COUNTRIES

Million lb.

Annual Average	Cotton Goods Exporters (1)			Cotton Goods Importers (2)	
	Cotton Consumption	Cotton Goods Exports	Cotton Goods Imports	Cotton Consumption	Cotton Goods Imports
1910-13	5,860	2,810	600	170	600
1926-28	5,640	2,460	500	210	750
1936-38	5,300	1,910	200	310	850
1949-51	4,050	1,300	330	540	860

COTTON GROWING COUNTRIES

Million lb.

Annual Average	RAW COTTON EXPORTERS											
	Africa (3)			Pakistan (4)			U.S.A. (5)				Other Countries (6)			
	Cotton Consumption	Cotton Export	Cotton Goods Import	Cotton Consumption	Cotton Export	Cotton Goods Import	Cotton Consumption	Cotton Net Export	Cotton Goods Export	Cotton Goods Import	Cotton Consumption	Cotton Net Export	Cotton Goods Export	Cotton Goods Import
1910-13	—	30	100	—	360	200	2,400	4,400	100	20	280	980	—	480
1926-28	10	170	110	—	420	210	3,300	4,200	170	20	290	1,100	—	460
1936-38	10	460	170	10	580	250	3,300	2,330	80	30	660	1,930	—	380
1949-51	30	580	190	60	410	160	4,340	2,330	250	10	1,050	1,800	50	200

COTTON GROWING COUNTRIES

Million lb.

Annual Average	RAW COTTON IMPORTERS										U.S.S.R. and China (9)	
	India (7)					Other Countries (8)						
	Cotton Consumption	Cotton Exports	Cotton Imports	Cotton Goods Exports	Cotton Goods Imports	Cotton Consumption	Cotton Exports	Cotton Imports	Cotton Goods Imports		Cotton Consumption	Cotton Goods Net Imports
1910-13	800	830	190	350	450	40	20	20	240		960	600
1926-28	880	1,070	270	250	310	130	20	60	350		1,740	220
1936-38	1,380	990	510	340	110	330	30	180	290		2,740	50
1949-51	1,540	100	410	300	10	370	—	210	130		2,170	20

1. U.K., Europe excluding Scandinavia and Balkans, Japan.
2. Canada, Australia, New Zealand, South Africa, Southern Rhodesia, Scandinavia; non-cotton-growing African colonies; non-cotton-growing Far East, i.e. Indonesia, Ceylon, Philippines, etc.: non-cotton-growing South America, i.e. Chile, Uruguay, Cuba, etc.
6. Cotton-exporting South America, i.e. Brazil, Mexico, Argentina, Peru, etc.; cotton-exporting Near East, i.e. Egypt, Iran, Turkey, etc.
8. Cotton-importing South America, i.e. Venezuela, Colombia, Ecuador, Balkans, Korea, Siam, Indo-China.

NOTE

1949-51 figures for India and Pakistan actual; estimated for previous years on the assumption that consumption of cotton goods was proportional to the population of the two regions and that half exports of Pakistan cotton go to India.

Beginning with countries which are still exporters of raw cotton, Group 3 consists of the cotton-growing countries of Africa excluding Egypt, i.e. Colonial territories, and these show a remarkable increase especially in raw cotton exports and to a lesser extent also in cotton goods imports. Such territories now account for 10 per cent of the world's exports of raw cotton compared with half of one per cent in 1910-13.

For Group 4 I have taken Pakistan and estimated the trade of this territory prior to its separation from India. The figures show its great importance today as an exporter of raw cotton and as a market for cotton goods. The development of its cotton manufacturing industry is now proceeding rapidly, however, and the import trade is declining, partly as a result of this and partly as a result of the reduced standard of living usual in the early stages of industrialization.

The figures relating to the U.S.A. (Group 5) show the diminished importance of this country as an exporter of cotton. At the same time, however, she is only slightly less important than the cotton goods exporting countries of Group 1 as a producer of synthetic fibres.

Group 6 includes the other cotton-exporting countries of the Western hemisphere on the one hand and the Middle East on the other, and the figures show the greatly increased importance of these countries in the raw cotton trade. So great has been the development of these countries, as shown, for example, by their population increases, that they have been able, at the same time, to quadruple, under heavy protection, their cotton-manufacturing industry, thus seriously reducing the volume of imported goods.

The figures for India (Group 7) show how the heavy reduction in raw cotton production during the war and post-war period, combined with an increase in cotton consumption, has turned India into a net importer of cotton and a heavy exporter of cotton textiles. This movement began in the inter-war years when the protective duty was increased.

Group 8 consists of the minor cotton growing countries of Latin America, the Balkans and the Far East, who have now ceased to export cotton and have come to rely on imported cotton to support their manufacturing industry.

The last group consists of U.S.S.R. and China, of which the decline in the China market for imported textiles is the significant figure. The large increase in production shown in the earlier years reflects to a great extent the substitution of the hand-spinning industry by machine-spinning. The U.S.S.R. is now more important

as an exporter of raw cotton and one cannot ignore the possibility of considerable expansion in this direction.

The conclusion that may be drawn from this analysis is that the development of the cotton manufacturing industry in the non-cotton-growing countries of the world has so far proceeded at a reasonable rate, and the ordinary processes of commercial negotiation appear to have been sufficient to exercise a moderating influence, although recent increases in protection in Australia and South Africa are disquieting. The situation in the cotton-growing countries is quite different, and the development of the cotton manufacturing industry there appears to have been relatively uncontrolled. Since in general access to locally grown cotton is of little economic significance, it is clear that political considerations are important. It is fortunate, however, that in these countries exports of cotton are linked to some extent to imports of cotton goods and a strengthening of this link might be the best way of influencing policy.

MANCHESTER

NOTES ON THE ESTABLISHMENT OF BRANCH FACTORIES

by GLYN PICTON

I

I HAVE recently been engaged on a study of some Midland businesses which have established branch factories in South Wales, and was particularly concerned with the extent to which comparative costs of operating at the main works and at the branches had affected the establishment and location of the latter.[1] In these notes I shall raise some points which seem interesting for the theory of business behaviour.

II

If one came straight to this subject from traditional economics, one would expect to find the decision to establish a branch factory backed up by estimates of the comparative costs of operating at the main works and at the various locations which were considered. (The fact that statistics are or might be available from which comparisons might be made of operating costs at main works and branch, once the latter has been established, is a separate but irrelevant point.) In fact, there appears to be a paucity of information of this kind, and, indeed, even a distinct lack of interest on the part of the firms in the sort of questions which would be formulated in terms of total costs at different locations. Businesses seem already to have reached the decision that it was desirable for expansion to take the form of a separate branch, and the question which seems to have arisen then is 'What part of our organization can operate at the branch?' and not 'How will the cost of this process compare with its cost at the main works?'

The decision to establish a branch was commonly made in response to a very few factors which were treated as of overwhelming importance. In the background there would lie the usual post-war features of shortage of capacity and easy selling. Then, dominating the foreground, would appear perhaps the advantages of a new building or of a good source of labour. The choice of site would be largely in terms of these dominating influences, such as a plentiful supply of

[1] The study was assisted by the Board of Trade and was made as part of the research programme of the Faculty of Commerce and Social Science in the University of Birmingham. Close contact was made with six businesses whose range of products embraced accessories for cycles, for motor vehicles, and for aircraft; adhesives and abrasives; nuts and bolts; brassware; metal hollow ware. The argument of these notes rests mainly upon discussions with these firms, but it has also been influenced by my wider business experience.

apprentices for a toolroom, unskilled labour capable of adaptation to a new mechanical process, the absence of competing demands for labour by other factories. To firms operating in congested main works, it was often the spaciousness of a new building which was the major attraction; this provided the opportunity for an improvement in layout and the designing of new production lines. They would be conscious of many difficulties: transport and communication; green labour; weakened managerial control; provision of key staff; duplication of services like welfare. But these difficulties would be secondary to the prime advantages which the firms saw as being outstanding in their assessment of the whole situation.

I should like to suggest that this concentration upon certain influences in the location decision is because other, and often major elements in the total cost of a branch, once it is in operation, can be controlled by management regardless of location.

It was noted that in several cases the mechanics of the production process provided a control over material utilization and quality of work. Similarly, the speed of work might be determined by the mechanical equipment; indeed, in two cases, the process and the equipment were specially designed so as to give this control and thus in large measure overcome the difficulty of unskilled labour. The proposition may be expressed even more strongly in that firms may welcome operation at a branch in the following conditions: a spacious building; new labour, free from traditional habits of working and capable of training in new methods; a specially designed production line to make long runs of standardized articles.

Another feature commonly encountered was that centralized buying resulted in raw materials being delivered at the branch and the main works at identical prices. This again results in an essential lack of variation in an element of cost, regardless of the place of operation.

The effect of transport charges has to be considered also in terms of delivery of finished articles. In one case, it was noted that the products were distributed to a widely scattered market so that, given a sufficiently large statistical spread, it would be immaterial from the point of view of the burden of transport charges, whether delivery was made from the branch or the main works. The point was brought out even more clearly in another case where a firm operated two branches in South Wales. One branch catered for a widespread market and was located in the more remote western part of the region; the other supplied a market mainly around Birmingham and was established in the eastern part of the region nearer to this market.

The three factors, therefore, which seem to be important in determining the degree of control which can be exercised over costs are the

mechanical process, centralized buying and diffused markets. Various combinations will give different results and present different residual problems to the management. Thus, if machines determine the speed of work and the use of materials, and if materials account for a high proportion of total costs, then it follows that variations in quality of labour cannot have much influence. The problem which becomes important is the burden of overheads involved in the use of the machines so that, for effective operation, the branch must be used to its full capacity. It may be noted also, that control may be exercised *ad hoc*. If a specific case arises, for example, in terms of material wastage or speed of operation, then it can be attacked as one of the normal jobs of management. It is not, from management's point of view, a problem specific to location.

If the firm is satisfied with the degree of control which it can exercise over costs, then it is free to consider the place of the branch in the organization as a whole. One of the cases studied provided an interesting example of the sort of considerations which arise. The original thought was to transfer completely a department which was self-contained and whose removal would therefore cause a minimum of disturbance. Moreover, the labour in that department was relatively unskilled so that redundant labour at the main works could be readily absorbed in other departments and suitable labour was more likely to be found at the branch. In the event, however, the department was divided on the principle of specialization, one set of products being made at the main works and another at the branch. At the same time, the branch took over from another department that portion of its production which lent itself to standardization, leaving to the main works the products made to customers' requirements.

This distinction between standard and non-standard articles was encountered in another case. A branch was established to operate specially designed machines with unskilled and semi-skilled labour. In this case the division of work between the branch and the main factory was not in terms of complete products but of processes; long standardized runs are undertaken at the branch, whilst small-scale specialized work is done by the skilled labour at the main factory. This sort of division of work is often a major objective of an organization in establishing a branch and explains the attraction of a new building, which facilitates the installation of the new production line.[1]

The idea of separating discrete processes was encountered repeatedly. One case showed it clearly: in establishing the branch, the firm followed its usual policy of specializing processes at its different

[1] It is interesting to note a similar principle operating in the clothing industry. cf. *Costs in Alternative Locations: The Clothing Industry*. D. C. Hague and P. K. Newman, National Institute of Economic and Social Research ,XV, C.U.P. 1952, p. 52.

factories, so that the branch undertook the whole of its production of hot brass pressings. In another, the firm was impressed with the importance to the workers of seeing the results of their labour in the form of completed products rather than sub-assemblies, and this factor, among others, determined the specialization of their total output as between the two factories. In one example, an important initial stimulus to the establishment of a branch was the desire to split the organization into units of some 500 employees, in order to improve personal relationships between management and men, and thus improve the efficiency of labour, the factories generally being separated on the principle of product specialization. An interesting complication in the organization of this firm arose from the secrecy of some of the processes, which were, therefore, subdivided for allocation to different factories. (This firm also provided an example of a classical locational factor. One of its materials, cellophane, becomes brittle and difficult to work in a cool dry climate, and South Wales was chosen for its warm damp atmosphere. It did not appear to have contemplated Lancashire!)

The allocation of work between branch and main factory may not always be to the benefit of the former. As we have seen, the advantages of skilled labour and management will often dictate the placing of a difficult non-standard order with the main works. But, on occasion, the problem will be one of mitigation of losses, and a branch factory with flexible equipment able to operate with smaller units can be of value when it is a question of absorbing losses on behalf of a whole organization. It was noted that, in one case, the crucial factor in operating costs was the decision to put unsuitable orders into the branch in its second year, owing to a shortage of the work for which it had been designed.

III

In suggesting that cost comparisons have not been of direct immediate significance in the establishment and operation of branch factories, it is not necessary to suppose that firms are oblivious of costs. In establishing a branch they may content themselves with a cursory examination of different sites, make no estimate of probable costs, lay down a production line and commit themselves to producing at the branch an integral part of their output, without comparing costs at the branch and the main works (and, in one instance, without even making any inquiry about rental). But, although costs may not be of immediate significance, it is possible that they may eventually attract more attention. The branch may be regarded in some

measure as a tentative experiment in terms of the current market conditions, with a degree of flexibility in decisions for the future. Present costs may be absorbed or passed on to customers, but eventually they may be worth while investigating. It may be noted, in passing, that the maintenance of cost records is itself an expensive operation, the results of which must justify the outlay incurred. Such investigations, however, if and when undertaken, may not be in terms of comparisons between two locations. The interest in costs may be generated when the firm has already committed itself to the branch and no longer conducts similar operations at the main works. The comparison then will not be with costs at the main works but with standards determined, for example, in relation to selling prices, or by techniques of work measurement and job analysis.

The analysis of those factors which are significant to the firms in their operation of branches, has important implications in the event of a recession. It may be suggested that insofar as the decision to establish a branch is taken in terms of the organization as a whole, a similar assessment may be made if the firm has to contemplate a reduction of capacity. Again the question may be, not 'How does the cost of this process at the branch compare with its cost at the main works?' but 'What part of our organization shall be eliminated?'

The answer will be fairly simple in cases where the branch is no more than a rapid response to a temporarily inflated order book. A factory taken on short lease and filled with light machines served by unskilled labour can be established without much delay by an impatient production manager; it is unlikely to survive in a recession.

The pattern may, however, be more complicated. In the short term, the firm may continue to operate the branch actually at a loss, for reasons such as those already discussed: the expectation of a reduction of costs by *ad hoc* measures, or the mitigation of losses for the whole organization by the use of flexible equipment at the branch. One case provided an instance of an unwillingness to dispense with a labour force built up with some difficulty. In other words, the firm considered not the question of the relative efficiency of the labour and its influence on cost, but the significance of the availability of the labour force at the branch to the organization as a whole.

But short terms must end. In order to survive as an integral component of the organization, the branch must have generated permanent influences strong enough to justify its continuance. Its position will be the more favourable if it has progressed to the stage of managerial autonomy; the more claims it makes upon the time of the chief executives at the main works, the more attractive will be the managerial economies to be realized by closing the branch.

The strength of the branch will be discovered by assessing its relation to the entire organization, and this may be done by using the factors analysed above. In a period of recession, some of the overwhelming advantages of the branch may disappear: for example, labour may become available in the neighbourhood of the main works. On the other hand, there will remain the advantages of a large building with a spacious, well designed layout. Similar opportunities may, indeed, become possible at or near the main works, but a degree of inertia will be present in the very existence of the branch; the firm may have incurred heavy capital commitments in the site, the building and the equipment.

In estimating the permanence of a branch it will be valuable to seek for the pattern which was suggested as a form of control over major elements in cost: the mechanical process, centralized buying and diffused markets. Insofar as these are present, the firm will not be stimulated to transfer production from the branch; it can control costs there just as well as at the main works, and in the absence of any other stimulus there is no reason why the branch should be closed.

One of the greatest single influences upon the permanence of a branch is that of specialization. If the firm has adopted the policy of allocating discrete processes or products to its separate factories, it follows that the branch bears for the organization the sole responsibility for a part of its production. If that part is essential, then the branch cannot be closed in a recession until other influences are generated strong enough to compel the uprooting of the work of the branch. The brassware case mentioned above provides an interesting example: the branch acts as the only press shop for the whole firm, as part of a deliberate policy of specialization applied to its various factories; the organization, therefore, unless it is prepared to put the work out to other firms, cannot operate without the contribution to its output which is made by the branch.

In conclusion, it is impossible to make very detailed generalizations on the basis of a highly restricted investigation, but if the pattern of cost-influences has been correctly discerned, then the branches are likely to counter-balance their inherent weakness of diffusing the managerial strength of a firm. Moreover, it then follows, the location of the branches was in large measure immaterial to the firms, and they were at little disadvantage in being induced to establish them in Development Areas. But the pattern then merges into another design of social costs, which will require a much larger canvas.

UNIVERSITY OF BIRMINGHAM

SOME CRITICAL REMARKS ON THE SIGNIFICANCE AND USE OF THE BREAK-EVEN POINT

by J. L. Meij

1. *Introduction. The Break-Even Point and Profit Maximization.* During the last few years there has been, in theory as well as in practice, a growing interest in what is called nowadays the break-even point. It is the point in the volume of trade of a business where there is neither loss nor profit, in other words it is the point where revenue just equals costs. To find this point may seem to be a very simple question. If you know the scale of revenue and the scale of costs, then it is simply the point where both scales intersect. Why is that point interesting? A business is not an institution to equal revenue and costs but one that seeks to make profit. Therefore we ought to be interested not in the break-even point but in the point where profit is at its maximum. The volume where total costs equal total revenue is not that which the business man must try to reach, but that which shows the greatest distance between total revenue and total costs. As the reader knows, that point can be found by a direct comparison of total costs and total revenue, as well as by a comparison of marginal costs and marginal revenue, or finally, also, by a comparison of average costs and average revenues.[1] Every one of these methods with their defects and their merits are discussed broadly in economic literature. It seems superfluous to give an exposition of them now.

All these methods, however, have a common condition for their application; this is that we have, for a certain period, an accurate knowledge of our scale of revenue as well as of our scale of costs. This condition will never be fulfilled in actual life. The best that can be said of our revenue-scale during a period of time is that it is, as Wilford Eiteman has called it, a 'twilight-zone'. The scale of costs is composed only of our predictable sacrifices at the beginning of the period. Under these circumstances a comparison of costs and revenue-scales is of little significance in business.

For this reason business men have chosen another starting point for the planning of their activity. They try to fix a sales-price and to get orders on that price up to the limit of the capacity of their plants.

[1] This last method, introduced as far as I know by Georges Lutfalla, is not the least interesting. Lutfalla draws above the average total unit costs a map of iso-profit-curves. The point where one of these latter touches the average revenue-curve is the profit-maximum-point.

This sales-price is composed of the average costs per unit and a profit-percentage. In fixing this profit-percentage two sets of considerations are of interest. The first is a consequence of the fact that in the calculation of the unit-costs only those can be taken into account that are known in advance. First of all, then, the profit-percentage has to cover these non-predictable sacrifices, as well as net or true profits.

The second group of considerations to which Mr. Andrews has drawn our attention[1] concerns the prevention of new entrants in the market. Considerations of this kind fix the upper limit of the profit-percentage. If the industry has not a protected position, as has a monopoly, and under stable conditions of the market, both sets of considerations will lead to about the same percentage mark-up. For everyone has about the same costs and the same uncalculable sacrifices.

Under the condition of business-behaviour here described the fixing of break-even points becomes of interest. It shows the turnover at which returns equal costs, in other words, where business breaks even.

The turnover becomes the compass on which business is sailing and the critical point is the break-even point. If the turnover falls towards the break-even point more sales-efforts must be made and eventually price must be reduced, though business men are in most cases very reluctant to do so. For the majority of business men price-cutting is the measure that only becomes actual after all others have failed.

As a help in sales-policy the break-even point has been used in practice for many years. It is not a new discovery, it has not broken open a new era in business-policy as has been suggested in recent years, particularly in American literature.[2]

In theory, also, from the beginning of the study of business economics as a particular part of economic science, students have called attention to the break-even point.

Nowadays, however, particularly in the United States, interest in the use and significance of the break-even point has been roused in such a manner that critical reflection becomes urgent.

2. *Short Exposition of the Break-Even Point Technique.* The different methods of fixing break-even points are well known, but a short exposition here will be useful in the following critique.

[1] *Manufacturing Business*, by P. W. S. Andrews, London, 1949.

[2] A. W. Rautenstrauch and R. Villers, *The Economics of industrial management*, New York, 1949.
Clinton W. Bennet, chairman of the N.A.C.A. in his recommendation of this book.

Since sales price is taken as given, the curve of sales-return is a straight line from the origin. For the sake of simplicity costs are considered also as a linear and continuous function of sales. The point of intersection of sales-curve and cost-curve is the break-even point. The point indicates the volume of sales at which a business breaks even.

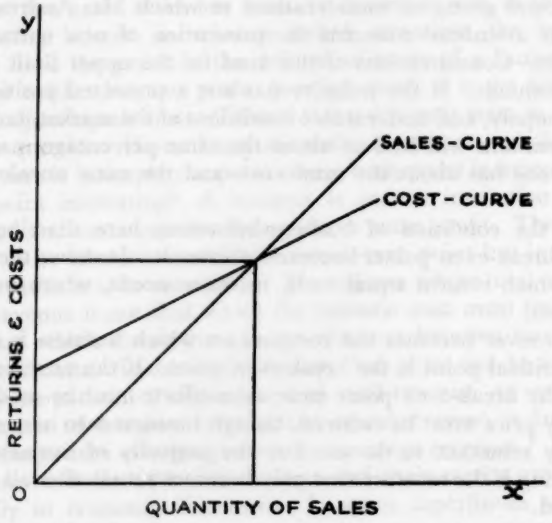

FIG. 1

In the graph given above the x-axis shows sales-quantities. The sales-curve shows the returns to these quantities sold at the given sales-price; the cost-curve, being the sum of constant and variable costs, is also represented as a linear function of sales-quantities.

It is also possible to place sales-dollars or sales-pounds along the x-axis; the cost-curve then must be interpreted as a curve of costs of sales-dollars or sales-pounds respectively. Still another way of representation is to place the degree of occupation of the plant along the x-axis. Then costs and returns are seen as functions of the degree of occupation.

Finally we can find a break-even point by using the gross profit-rate.

To distinguish these different ways as such is perhaps not very important. Nevertheless it has a certain importance for the application

of the break-point technique to multiple-product industries. This question is to be treated in section 4, but first we have to consider the consequences of discontinuous cost-functions for the break-even point.

3. *Discontinuous Cost-Functions and the Fixing of Break-Even Points.* Discontinuous cost-functions are commonly seen as a consequence of the indivisibility of means of production. In my opinion divisibility or indivisibility is of no importance.

Indivisibility only means that we have to buy a lot of units of the instrument at once. But this is true for all instruments of production, for raw material as well as for machines, for labour as well as for the services of other industries.

We have to distinguish between instruments of production which depreciate in proportion to the use we make of them, and those which wear out in proportion to time.

Discontinuous cost-functions are to be seen as a consequence of the latter. When a machine or another indivisible instrument does not become obsolete in course of time, the use of it will show a continuous cost-function. On the other hand, if stocks of a raw material become obsolete as time goes on, the raw material shows a discontinuous function. It will be clear that in our dynamic society nearly all instruments of production will cause discontinuous functions. For different sorts of costs the discontinuity will be different. Perhaps we may make an exception for raw material if normal stocks are relatively limited.

What does discontinuity mean? It means that in expanding production the majority of costs are increasing intermittently at larger or smaller intervals and by larger or smaller amounts.[4] But it means further in this particular case that after new investments have been effected these costs will remain constant at a higher level, the cost-curve being shifted to a higher level than before. This cost-constancy is nevertheless of no long duration. It depends on the time during which the new instrument lasts. When it is worn out we can take a decision about its renewal and then it is possible to reduce costs by the amount of that investment.

Fig. 2 shows costs as a discontinuous function of the volume of production.[5]

[4] We may call these costs 'overhead' costs but we must bear in mind that almost all costs are overhead then, since nearly all costs vary intermittently with the volume of production.

[5] For the sake of simplicity we have supposed that after the new investments have been effected the slope of the total-cost-curve remains unaltered. This is not necessary, as the reader will understand, but in our argument an alteration of slope is not important.

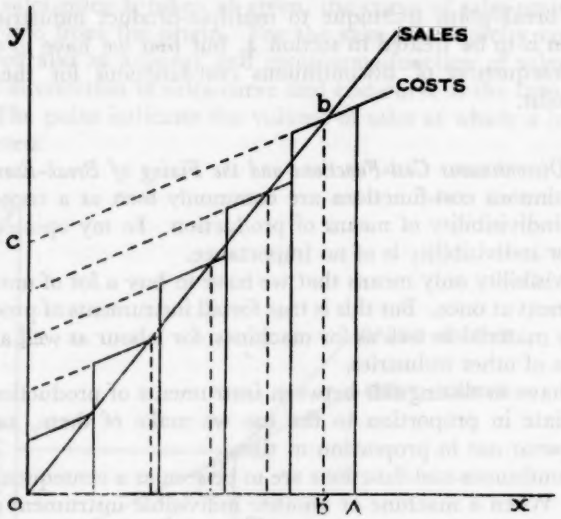

FIG. 2

The sales-curve in this graph intersects the 'cost-cascade' at different points.[6]

What point of intersection is the break-even point? We cannot answer this question without knowing what the capacity of the plant is at the particular moment of time. Capacity must be defined as the volume that can be produced if the plant is normally used. If OA represents that volume, b will be the break-even point and b' is the volume of production where business breaks even. OC is the level of costs we may consider constant in the actual situation of the plant. For every increase in the volume of production we have to make new inputs which last for a more or less considerable period of time. Therefore in expanding the volume of production, the level of constant costs, the point of intersection of the total cost-curve with the *y*-axis, becomes higher and higher.

As we have seen, cost-constancy as well as capacity is a relative idea. The constant cost level may be lowered within a week or a month by discharging some labourers, foremen, supervisors, and over a longer period by not renewing machines and so on. The break-even point is then removed to another point of intersection.[7]

[6] The intersections with the vertical parts are not true points of intersection, as the reader will understand.

[7] As far as costs vary continuously in relation to the volume of production the change will already be allowed for in the slope of the cost-curve. But we are speaking here only of costs that vary discontinuously.

It will be clear that the break-even point as a critical point in the sales-revenue of a plant particularly becomes of value if trade diminishes. But in that case we may expect that the break-even point will be removed from higher points of intersection to lower ones.

What then is the value of the break-even point? In my opinion the significance of the break-even point is very exaggerated. Instead of being a constant point independent of sales-volume it is a variable of that volume. The break-even point is not a compass we may rely upon in the long run, for in the long run it is dependent itself on the course we are sailing.

4. *Break-Even Point Technique and Multiple-Product Industries.* Hitherto we have studied the significance of the break-even point under the most favourable conditions. Real life does not present those conditions often. So far we have given no attention to the fact that almost every plant is equipped for the production of more than one sort of product or at least for more than one quality of a sort. Moreover, even in the relatively rare case when but one article in one quality is produced, we are not sure that our production is, economically speaking, homogeneous. Economic heterogeneity can also be caused, as we know, by the structure of demand. Different moments at which goods are to be delivered, different size of orders etc., are all factors that can cause economic heterogeneity even in a technically homogeneous production. Therefore we understand that the applicability of the break-even point calculation in multiple-product industries is a question of 'to be or not to be' for this technique.

There are cases where the quantitative relations between the different products are invariable so that the whole production can be considered as a homogeneous one. But these cases are rare, and even in this case the condition of economic homogeneity may be still unfulfilled.

Under the conditions of real life, it is clear that we cannot use a break-even point to define the quantity of turnover we must reach before making a profit. It is impossible to compute quantities of different sorts of goods. But may we eliminate those quantities, giving our attention only to the money-turnover or to the degree of occupation of the plant? In the literature of our subject, indeed, the break-even point is commonly used to fix the amount of money or the degree of occupation where revenue equals costs. We are not obliged to add quantities of different products in doing this but the influence of the mixed composition of turnover is not eliminated.

We are able to imagine a sales-curve with a definite slope if we

have reference to turnover either as an amount of money or as a degree of occupation, but costs are not independent of the composition of this turnover. A variance in the turnover of different goods means also a variance in the discontinuity of costs. Increasing production of one good, e.g, requires more labour, an increase in another, more machinery, and so on. The cost functions are still changing and with them the situation of the break-even point.

We can only use the break-even point if we are sure that variances in the volume of turnover are not accompanied by changes in its composition. This is a nearly impossible supposition. Every sales-manager knows that variances in the turnover always are accompanied by relative changes in the quantities sold of the different products. The factors that vary the turnover do not act in the same degree on its components. Moreover it is a well-known fact that diminishing turnover is commonly accompanied by diminishing size of orders, increasing turnover on the contrary by orders of increasing size.

Little has to be said now about the fixing of the break-even points by means of the gross profit-rate. In this technique the gross profit-rate is defined as the difference between revenue and variable costs expressed as a percentage of revenue. One can fix the break-even point by asking at which turnover gross profit is just sufficient to equal constant costs.

It is not difficult to see that this question can be answered only if the composition of turnover remains unchanged.

5. *The Current Solvency Point.* Our contemplations would not be complete if we paid no attention to another sort of break-even point called by Mr. Andrews the current solvency-point.[8] It is the point where total paying-out costs equal total sales-returns.[9] It is not or not directly related to price and sales-policy but to the liquidity-situation of the business.

This point, as will be easily understood, lies nearer to the y-axis than the ordinary break-even point. Only a less or greater part of total costs are paying-out costs. The situation of the point is not more constant than that of the break-even point. Total paying-out costs are composed of different items payable at different moments. Wages and salaries are payable weekly or monthly. Raw material is delivered under varying conditions; sometimes it must be paid

[8] Op. cit., p. 260.

[9] Paying-out costs are not comparable with volume of sales but with sales-returns or sales-receipts.

within a month, sometimes within three months, and so on. Intermittently we have to pay for new machinery.

We can only consider the current solvency-point as a stable point if we may assume that the conditions on which we can acquire all these means of production and the way we can finance this acquisition remain constant. In reality we often see that credit-terms become longer if business diminishes. This means that paying-out costs are diminishing not only in relation to sales-return but also to changing credit-facilities and changing methods of financing.

6. *Summary of Conclusions.* In spite of the great significance which is imputed to the calculation of break-even points, in theory as well as in practice, we must conclude that it is not a very important instrument in sales-policy.

For single product plants, 'single product' being understood in the strict economic sense, it may be useful in the very short run, a period without changes in the instruments of production. In nearly all practical cases, those of multi-product plants, its use has still more limitations. The composition of turnover must remain unchanged or in changing this composition the cost-structure must remain unaltered.

Though the current solvency-point has more applicability, we may still ask if there are no better means to satisfy the need for insight into the financial situation of a plant. Periodic statements of actual and potential liquidity will fulfill our needs in this respect much better.

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PRICE POLICY IN THE COAL INDUSTRY

by A. Beacham

I

This subject has recently been attracting a great deal of attention[1] and this article does not purport to be a comprehensive treatment of it. There is little to be gained, for example, by repeating the pros and cons of marginal and average cost pricing which have been set out by the Ridley Committee or by summarizing the arguments of Mr. Dennison against uniform delivered prices. The question raised in this article is whether, and (if so) why, the National Coal Board (N.C.B.) needs to have a price policy. Is not price a matter about which it can be fairly passive and leave to look after itself? This, after all, is a fairly common attitude in private business. It was true of many coalowners within the recollection of the present writer. Price mattered enormously to them but it was treated mainly as an external phenomenon about which they could do nothing. If a price policy is necessary, what is it and what should it be? If prices are things to be fixed and not things that just happen do we try to fix them at the level they would probably have taken in a free market and are they intended to serve the same purpose? If so, it would surely seem to be a very laborious way of setting about things. But perhaps price is now intended to be something different — an accounting symbol to be moved this way and that in the interests of the balance of payments or the welfare state or some such worthy object. We shall suggest that the Board has never quite made up its mind. Prices should be (it seems to think) what they were in a competitive private enterprise system, the very stuff of which was profit and loss. This it has found difficult to practice in a publicly owned national monopoly which must try to avoid both profit and loss.

Several circumstances suggest that the N.C.B. is both obliged to formulate some sort of price policy and has unusual opportunities for deliberative pricing. It has a virtual monopoly of the supply of coal to the home market (where it disposes of the bulk of its output) and where demand is almost certainly inelastic. It is instructed that taking one year with another it must balance its budget, i.e. it must neither maximize its profits nor incur losses.[2] Moreover a general shortage of coal exists (in the sense that more

[1] 'The Price Policy of the National Coal Board', by S. R. Dennison, *Lloyds Bank Review*, October 1952. *Coal — The Price Structure*, Federation of British Industries. Report of the (Ridley) Committee on National Policy for the use of Fuel and Power Resources, cmd. 8647.

[2] See the Postscript to this article.

than current output could be disposed of at current prices) and seems likely to continue for some time yet. In other words, current output could be disposed of at higher prices than those now ruling. It would seem therefore that to a quite abnormal degree the price of coal is very much what the N.C.B. chooses to make it.

Before proceeding further several preliminary comments are necessary. An important distinction needs to be drawn between the general and the particular. Coal is not a homogeneous commodity but is made up of a large number of grades and classes differing in their physical and chemical characteristics and more or less well adapted to particular uses. There is, therefore, no price of coal, though we can think of a general price level of coal in the sense of average proceeds of sale. There is a complex constellation of market prices of different grades which we shall call the price structure.[3] The essential feature of the price structure is the relativity of the different prices rather than their absolute level. The price level is not a simple average of the price structure since total proceeds depend not only on the prices of particular grades but also on the amounts of them that are disposed of. Important changes in the price structure might take place without affecting the price level. Proportionate changes in all market prices would affect the price level without affecting the price structure. Indeed, one may conveniently think of the price level as being affected in the main by general causes such as inflationary influences in the economy at large or new mining discoveries, whilst the price structure is predominantly affected by special causes such as technical changes in the efficiency with which different coals may be consumed. But it would be a mistake not to recognize that the one can, and often does, have a great deal of influence on the other. When, during the war, the price level of coal was kept abreast of cost increases by flat rate increases in the price of all coals, the price structure was considerably distorted in consequence.

In a free market this price structure is determined by the subtle inter-play of consumers' demands and producers' responses. Each will bid for the coal which is most economical for his purpose, which will not necessarily be the coal best physically and chemically suited to that purpose. Each producer will so far as possible adjust supplies from different seams and pits so as to maximize his profits, each producer striking his own balance between long and short term advantage.[4] The forces at work in this process are of considerable

[3] Although the general demand for coal may be inelastic, the demand for any particular grade may respond quite sharply to small changes in its price.

[4] An important consideration in working a wasting asset.

complexity. For example, changes in boiler design and firing techniques may make possible the burning of untreated small coal which was formerly valueless. (It might even appear to have negative value to the coalowner since it is expensive to dump and liable to spontaneous combustion.) A market therefore develops for small coal at a nominal price. Demand may exceed supply and price rises to keep the market in balance. Coalowners plans are now affected. An incentive has been given to expansion of the production of certain friable coals, and even to the introduction of machine methods which tend to increase the proportionate output of small coal. The rise in the price of small coal is checked, but the output of large coals of certain qualities has been increased and *cet. par.* the prices of these will fall. The fall in these prices will set in train another series of reactions, and so on. It is clear that there is no price structure which is just right except in relation to an extremely short run situation. Producers and consumers take the existing price structure for granted, but in responding to changes in tastes, techniques and methods of organization both within and outside the industry they modify it. It is always in a state of flux as it struggles to produce an equilibrium of market forces which it can never achieve except in a static society. It would certainly be no easy task to reproduce by any deliberative process the results of this intricate market mechanism, if in fact this is what the N.C.B. wishes to do.

It needs to be recollected at this point that the quality of a coal (in the sense of its desiredness by particular classes of consumers for particular purposes) is not necessarily closely related to the average cost of production. Thick seams of excellent coal may lie in undisturbed ground very near the surface, or vice versa. As against this, as is pointed out below, each class of coal tends to be worked up to the margin of profitability given the price structure. In a very general way it would be true to say that under private enterprise the production of each class of coal would be taken to the point at which marginal cost equalled price, but that there would be a wide difference between average and marginal costs, so that some concerns would be working at a handsome profit whilst others struggled for existence.[4]

II

We can now proceed to inquire what the policy of the Board is. It may be said at the outset that the N.C.B. is often confused and contradictory in what it says on this subject. The fact that it is

[4] In theory these profits should have been appropriated as rents by royalty owners.

required to 'break even' suggests that the price level should be based on the national average cost of production. The following quotation suggests that this principle has been extended to the prices of particular grades. 'The Board have adopted the principle that in the long run the prices of particular coals delivered in market zones should as far as possible cover the cost of producing and delivering those coals.'[6] This cannot mean marginal cost in the sense of covering the cost of producing those coals under the least favourable conditions. If this were so, no pit would make a loss but many would make profits and this would be inconsistent with the break-even principle. Nor can it mean that each pit's output of a class of coal will bear a price reflecting its average cost of production at that pit. For this would mean that the pit-head price of the same class of coal would vary from one pit to another, and the Board has set its face against this even to the extent of co-ordinating *delivered* prices of the same class of coal. But if we are right in supposing that each class of coal is priced at its national average cost of production, then some pits will make profits and others losses although the industry will break even. Some references suggest, however, that individual pits will be required to pay their way in the long run.[7] This implies that price in general will have to cover the costs of marginal pits, so that the industry as a whole will make handsome profits. We suggest below, however, that this can be reconciled with the foregoing if '*in the long run*' is sufficiently stressed.

It needs to be emphasized that the Board is here referring to the prices of particular grades, and that prices fixed by reference to costs would need to be adjusted in the light of consumer preferences etc. But the vagueness as to whether marginal or average costs is meant persists. It is impossible not to have some sympathy with the Board as it flounders in the morass. No simple straightforward statement of the pricing formula is likely to pass muster. What was formerly taken for granted is not now so easily explained. In so far as they have a policy on the price of coal in general it is fairly certain that it is to base it on average costs, i.e. to break even. Moreover, there is a rough and ready attempt to apply the same principle to the different grades of coal. Confusion has arisen because the Board will not readily face the implication that this means allowing some pits to work at a loss. To state this too openly[8] would badly undermine its case when trying to close uneconomic pits, and might also

[6] *Plan for Coal*, paragraph 159. Cf. paragraph 161, viz. 'The Plan aims to shape production in future so that proceeds will cover costs.'

[7] See 'Planned Investment in the Coal Industry', by A. Beacham, *Oxford Economic Papers* June 1951, pages 128-30.

[8] Though it is stated clearly enough in paragraph 523 of the N.C.B. Report for 1947.

undermine such incentives to efficiency as remain in the industry. What the Board seems to be meaning is that, whilst (when prices of each grade are based on average cost) some pits will make profits and others losses, development will be pressed forward at the former, so that in the long run pits will be required to pay their way if they are to survive. But there is such confusion between the general category of coal and the particular grade of it, between average and marginal, between extensive and intensive margins and between the long run and the short run that it is impossible to be sure about this.[9]

The Board has concentrated most of its efforts on reforming the price structure. It claimed that some change in the price structure was made necessary by the distortion which war-time flat-rate price increases had produced. The high quality coals were made relatively cheap and the low quality coals relatively dear. The market would normally have forced correction of a faulty price structure by leaving the over-priced coal unsold but this did not in fact happen because coal was in overall short supply. When the Board came to think out the principles on which the new price structure should be based, they obviously tried to rationalize what they believed to be the essence of the market process. The price of each grade should reflect on the one hand its (average?) cost of production and on the other the relative strength of consumers' demands and preferences for the different grades. In this way it was believed that the price structure would facilitate the Board's task in meeting the demand for coal most economically. Lowness of price would encourage consumers to take more of those coals the supply of which could be increased most easily and cheaply,[10] and the strength of demand for particular grades would show which coals were most favoured by consumers from time to time. 'A rational price structure is needed both to promote the efficient use of coal and to help the Board in deciding upon their production plans.'[11] It would seem to follow that the price structure would need to be very flexible so as to reflect the future play of market forces, but it is difficult to reconcile this with the rather mechanical rigidity with which the initial structure of prices has been worked out.

The home market appears to have been divided into three sections — house, industrial and carbonization coals. House coals were

[9] We have not dealt here with the relative merits of average and marginal cost pricing. This has been fully expounded by the Ridley Committee.

[10] Here the inference appears to be that prices are based on marginal costs. There is great confusion on this point throughout all the Board's statements on price policy.

[11] *Annual Report* of the N.C.B., 1950, p. 28. Cf. The *Plan for Coal*, para 159 'The principle the Board proposes to follow implies not only a price policy but a policy of shaping production so as to meet consumers' demands most economically'.

arranged in eight groups to reflect the quality of the coal and its acceptability in the domestic market. The country was divided into sixty zones and uniform delivered prices fixed for each group in each zone. The relative price levels of any group in each zone reflect the average cost of transporting the coal and are highest in those zones furthest away from the collieries.

The scheme for industrial and carbonization coals was much more elaborate. The object was to produce separately for industrial and carbonization coals, an order of merit which would reflect the preferences of rational and well-informed consumers. Taking industrial coals first. Each coal has been given a description showing its rank,[12] mode of preparation, calorific value and ash content. From this description the points value of the coal can be worked out, i.e. calorific value in B.Th.U.'s per lb. (less adjustment for ash content) divided by 100. Each point is equivalent to so much money (4.59d. when the scheme was prepared in 1951, but it has since been increased). To this first rough price approximation certain fixed cash adjustments per ton are made for size and method of preparation (e.g. washing and screening). There are also minor adjustments for other special properties such as hardness or friability, sulphur content and so on. A similar method of evaluation has been worked out for carbonization coals, but the properties to be reflected in the price are rather different.

It seems, then, that the Board is now prepared to supply to all buyers a description of the coals produced by it and the price group to which such coal has accordingly been assigned by application of the principles outlined above.[13] Apart from various (and on the whole, minor) adjustments, the price of any grade of industrial coal is substantially determined by its heat content adjusted for ash. These prices are of course pit-head prices. The same class of coal would have the same pit-head price attached to it wherever it was produced (Pit A or Pit B). It would, however, sell to different consumers (X and Y) in (say) Bradford at different prices depending on the relative proximity of A and B to Bradford. If X was supplied from Pit A (which we assume to be near Bradford) he would get his coal more cheaply than Y who is supplied from Pit B which is assumed to be more distant from Bradford.

The N.C.B., however, do not want this to happen. The Board

[12] Rank is descriptive of the intrinsic nature of the coal and nine main groups or ranks are used. The rank generally moves upwards from anthracite (low volatile and non-caking) through the high volatile strongly caking coals of Durham to the high volatile non-caking coals of the Midlands.

[13] Some references suggest that relative prices will be fairly narrowly delimited by the points scale, other references suggest that they will be modified in the light of 'commercial considerations'.

have always had it in mind 'that the new price structure should provide for delivered prices, that is, prices which would be co-ordinated at the point of delivery as they would be in a free market'.[14] This means that the cost of transporting the same class of coal *to the same market* (or consumption zone) from different production points will be pooled. It does not mean that the same class of coal will have the same delivered price to all consumers irrespective of where they live. It means that consumers who are near to the pits will be allowed substantially to retain the advantages deriving from their location.[15]

But the delivered price system does involve some distortion of the pattern of production and distribution which would be established in a free market. In the main Mr. Dennison's criticisms are valid, and, as he says, it is difficult to see why the Board 'announces its intention of being guided in the main by price criteria and then goes out of its way to destroy such criteria as are available to it'.[16] It would appear that certain pits will now be able to compete in distant markets which would otherwise be excluded from them, but caution is necessary in advancing the criticism since it is extremely difficult to see how it is all going to work out in practice. It is impossible to calculate average transport costs of a particular grade to a particular market without previously estimating the tonnages to be supplied from various production points. The real criticism of the proposed system is that, since production and transport costs are averages, the relationship between individual pit costs (plus its transport costs to a particular market) and its selling price, which should indicate what stake it should get in such a market, is very much obscured. It *may* be that certain diseconomies will result. When certain supply points and tonnages are decided upon the price can be fixed to cover average production and transport costs. If subsequently it is discovered that some other selection of supply points and tonnages is more economical the effect will be to reduce average production and transport costs and therefore price. But there will be very little incentive for this to happen. If the system is worked so as to minimize production plus transport costs consumers as a whole will not suffer. Particular consumers will lose any advantage they might[17] previously have had in getting supplies from a near source, but it is difficult to see why they should benefit from this sort of fortuitous

[14] *Annual Report* of the N.C.B. for 1951, page 37.

[15] Mr. Dennison appears to think otherwise. See his article (previously cited) for a fuller treatment of the delivered prices question.

[16] Op. cit., page 27.

[17] In theory they would not get any such advantage in a free market. In practice they might have done prior to nationalization.

contact as compared with another consumer *in the same place*. There is probably more to be said for the Board's proposed policy than Mr. Dennison would have us believe.

For the moment the N.C.B. is merely fixing pit-head prices, but in order to achieve the sort of co-ordination at the point of delivery at which it ultimately aims it is adding a 'coalfield adjustment' to the prices arrived at in accordance with the procedure outlined above. Thus, for example, Kent was formerly able to compete in the London market because, although its costs and pit-head prices were high, transport costs were low. In the Midland coalfields production costs were lower but transport costs high. With the new price structure, the prices of equivalent grades in Kent and the Midlands would be the same and Kent would be shown to be working at a heavy loss. Until the new uniform delivered price policy is put into operation, therefore, Kent is given a coal-field adjustment figure of 13s. per ton, whilst (for example) the East Midlands for the most part gets nothing. This is in effect a crude instrument for preserving the present pattern of production and distribution and for securing approximate equality of delivered prices of similar grades in the same market.

In so far as the prevailing pattern of production and distribution has been produced by free competition it is difficult to criticize this temporary policy. But in fact this pattern relates to the 1920s rather than the present time. It was largely frozen by the selling schemes set up under the 1930 Coal Mines Act and probably bears little relation to the technical realities of the present time. Moreover, it is highly probable that even before 1930 consumers in some coalfields were being forced to subsidize competition in distant markets and were thus denied some of the economic advantages of their location. It is easy to deride the efforts of the N.C.B. in trying to reproduce in their price policy the results of a free market mechanism, but it is important to remember that what they have replaced constituted no sort of ideal.

If we put aside the questions of uniform delivered prices and of coalfield adjustments, it remains clear that the chief determinant of the price of a particular class of coal is its heat content adjusted for ash. But we are also told that the price of each class is to be the (average?) cost of producing it.[18] It would appear that these are only reconcilable in respect of the datum coal. The datum coal is a washed small coal of top size less than 1 inch but not less than ¼ inch with a points value of 112.5.[19] This was given an index price of 43s. per ton (i.e. one point = 4.59 pence as previously stated) which

[18] See above, page 143.
[19] See *Coal — The Price Structure*, Federation of British Industries, page 5.

price could, and probably does, reflect the average cost of producing it. But except by coincidence there is no reason to suppose that a 'better' coal of (say) 20 per cent higher points value will also be found to have a 20 per cent higher average cost than the datum coal. Such a result may, however, be brought about by subsequent variation in the outputs of different grades, and although this is nowhere clearly stated this is probably what the Board have in mind. If the 'better' coal mentioned above is in fact being produced at an average cost only 10 per cent above that of the datum coal, then clearly its production is very profitable and this may be taken as a signal to press forward with its production. There are, of course, limits to the extent to which the Board can vary production of different grades, and there is no knowing whether adjustment can proceed far enough to permit even an approximate equivalence of price both to 'merit rating' and average cost. Also, the argument assumes that additional quantities of a particular grade can only be forthcoming at rising marginal and average costs. This, however, seems to be a reasonable assumption in the short run where coals with particular physical and chemical qualities are involved. More of them can only be got in most cases by working less suitable seams, or by more intensive exploitation of existing workings, which may involve over-time etc. But some cases may arise where it is rather a question of additional treatment of coals, and here one would not expect rising costs except in the very short run.

We may reasonably suppose, then, that relative prices having been fixed mainly by reference to the physical and chemical characteristics of coal, these prices may also be made to reflect approximately the average cost of producing the coals in question, by gradually expanding the production of coals then shown to be profitable and contracting the production of those on which losses are made. This, it may have been reckoned, is what happens in a free market when demand price (the merit rating) exceeds supply price (average cost). But in a free market the restoration of equilibrium is much more complex. Demand price is a function of output, the 'merit rating' scale of the N.C.B. is fixed. In a free market as output expands (and, as we assume, average cost rises) demand price falls and further output expansion is checked. The danger is that the Board will over-expand the output of some categories and over-contract the output of others. Thus, in spite of all its efforts, the Board will not have achieved the ideal adjustment which it is seeking. It is perhaps hardly to be expected that a schedule of administered prices should reveal the flexibility and subtlety of prices which are the spontaneous outcome of competitive market forces.

At this stage of the argument it needs to be explained once again that a good deal of this is based on surmise. The Board has given no clear and coherent account of its price policy. But, unless some miraculous conflation of the merit rating scale and relative average costs is expected, it is difficult to make sense of coal price policy in any other way. The line of argument which is being developed here incidentally throws some light on the relationship of cost and quality. As has been stated earlier, there is not the same type of relationship in coal as one finds in manufacturing industry, where production conditions do not differ much between one firm and another and where quality reflects high average cost. Good quality coal may occur in such a way that it can be very easily mined. But from another angle there is a necessary and close relationship and the Board is not justified in commenting on the fact that high quality coals are high cost coals as if this were entirely a matter of coincidence. High quality merely indicates a coal which is so well adapted to particular uses that consumers will pay a very high price for it rather than use a cheaper substitute, e.g. Durham gas coal or Welsh anthracite. Such coals have been extensively worked in the past and can now only be won at a high cost per ton. A sufficient number of consumers place a sufficiently high premium on these coals to permit small tonnages of them still to be produced remuneratively. Perhaps consumers' preferences are strong enough to permit even larger tonnages to be produced at even higher cost and yet disposed of at a remunerative price. (This is the sort of question to which the Board is seeking an answer by 'rationalizing' its price policy.) But, even if by some new discovery the special coals could be worked in larger quantities and at substantially lower costs, the price would still be high. Prices would fall and these coals would force themselves into uses from which they were formerly barred by high price, but the existence of a hard core of consumers whose preferences for these coals were abnormally strong would always permit their working in relatively unfavourable conditions. In the long run, prices and costs would inevitably rise again. It would be a mistake to assume that in the coal industry, price, quality, and high cost are completely dissociated.

Reflection on the implications of the word quality suggests more fundamental criticism of the Board's price-structure policy. The structure is intended to reflect the relative preferences of rational and well-informed consumers.[10] Are the relative preferences of any two consumers ever exactly alike — or are they sufficiently alike for them to be standardized in this way? All that the layman can do

[10] Cf. *Annual Report* of the N.C.B., for 1950, page 28, paragraph 104.

in a matter of this kind is to indicate a little polite scepticism. Even if we assume that two industrial consumers are mainly interested in the heating qualities of coal, they may easily differ in their assessment of subsidiary qualities, each having regard to his own specialized requirements. In other words, two consumers who have formerly consumed coal B may look at the new price structure. One will find that his preferences have been correctly interpreted and that a better coal to him (C) is just that much higher priced, whilst an inferior coal to him (A) is just that much lower priced. The other may find, however, that (A) is technically a better coal for his purpose, in spite of it being lower priced.

The Board have taken part of the sting out of this argument by dealing with house, industrial and carbonization coals separately. Within these groups it may have reckoned that consumers' preferences are reasonably homogeneous. This may be doubted, especially with regard to the large and very general industrial group. Once again the question arises whether the Board will adhere rigidly to the new structure or allow market pressures to modify it. The 'ideal' nature of a free market price structure arises mainly from its responsiveness to consumers' reactions. There is no guarantee that the 'rational' price structure of the N.C.B. is anything more than a very rough approximation to this ideal result, since many more factors will weigh with consumers than the Board can formally take into account. As against this, it is probably true to say that in practice a free market price structure is a good deal influenced by ignorance and irrationality on the part of consumers, which is now eliminated. The N.C.B. can argue with some reason that it knows better than many consumers what is good for them. In the end, the decisive criticism of the scheme is not so much that it cannot be anything more than a crude approximation to the ideal, but rather doubt that any administered price structure can be sufficiently flexible to respond sufficiently to revealed deficiencies and the changing pattern of consumers' tastes.

Very much the same point was previously made with reference to prices and average costs. Assuming, however, that there *is* flexibility in the structure, what does the Board do when consumer preferences pull one way and production factors pull the other? If a significant number of consumers find a particular coal under-priced then they should be allowed to bid up the price. But this coal may already be priced above average cost and the Board will wish to reduce the price. Quite clearly the output of this coal should be expanded, which will go a long way towards restoring equilibrium, but meanwhile what should be happening to the price? The beauty of the

pricing system in a competitive economy is that such matters can be allowed to sort themselves out. But in the coal industry price is a thing to be fixed and it is someone's business to decide in accordance with some obscure formula whether it should move up or down or be left alone. In the circumstances described above, it might be most important that some price adjustment should take place, but it is difficult to see how these conflicting forces can be measured and the right adjustment made.

There can be little doubt that unless there is a very strong presumption in favour of a certain course of action the tendency will be to leave things alone. The new price structure will slowly solidify[21] and consumers' buying programmes and the planner's production programmes will accommodate themselves as well as possible to it. Price will no longer be a sensitive indicator of the direction of desirable change, and it will be difficult to persuade oneself that the Board is carrying out the duties so admirably set out in clause 1 of the Nationalization Act.[22] But whatever its deficiencies there can be no doubt that it can be made to work so long as the overall demand for coal exceeds the supply at current prices. If at any time this ceases to be the case, the Board may make the alarming discovery that the biggest obstacle to deliberative pricing by a national monopoly is the uncontrollable and unpredictable consumer.

III

The following conclusions seem to emerge from this brief commentary on the pricing policy of the N.C.B. Firstly, that the Board can hardly avoid the necessity of having a price policy and is well placed to experiment with some form of deliberative or 'rational' pricing. Within fairly wide limits price is very much what the Board chooses to make it and it must be prepared to explain and defend what it is doing.

Secondly, it is not at all easy to follow the explanation provided. We are told that the industry must break even, individual pits must pay their way, the price structure must be based on costs (*sic*) of production plus costs of transport of each grade, the price structure must be based on a points scale based on the physical and chemical properties of coal and reflecting the preferences of rational consumers, and much else besides. In order to analyse this pricing policy a good deal of explaining away of apparent inconsistencies is necessary. Criticism may be misplaced because the interpretation is at fault.

[21] This of course does not prevent the price level moving.
[22] 'Securing the efficient development of the coal-mining industry, etc.'

Thirdly, the Board has obviously tried to model its policy on what it thinks happens in a free market. It is hoped to arrive at prices which will guide the industry towards the most economical and efficient production policy. There can be little doubt that the Board has enormously under-estimated the complexity of market processes and the difficulty of getting the right answers without restoring a free market. As Mr. Dennison has said 'It is not easy to provide a grin without a cat'.[33] But when Mr. Dennison goes on to urge a restoration of a free market comparable to that of pre-1930 he is surely arguing for a policy that is not really open to the Board, however acceptable it might be to economists. It would mean a reversion to pit-head prices, each pit relating its prices to its particular costs. Some dislocation of markets would certainly result and, unless pits were invited to make profits where they could, it would be an invitation to technical inefficiency for many. Moreover, unless maximization of pit profits were encouraged, the policy would not yield the results which it should. It is difficult to say what would happen but prices might rise and also profits might be considerable. The former would be unacceptable to the Government and the latter would be incompatible with the break-even principle enshrined in the Nationalization Act.[34] But the decisive argument against Mr. Dennison's suggestion is simply that the miners would not have it — and, from their point of view, for very good reasons.

Fourthly, we need to consider whether there is any advice we can give to the Board. Frankly, I would suggest that it thumbs its collective nose at the economists. It could state boldly that the so-called free market in coal never provided the right answers anyway whatever the textbooks might say — partly because it never was a free market. Also (the Board might continue) such a free market does not provide the right criteria for a nationalized institution which seeks not to maximize its profits but something called the public interest, which they are to judge for themselves subject to direction from the Minister of Fuel and Power. The Board should sit pat upon the Nationalization Act and evolve its own criteria for pricing policy in conformity with it, and then challenge the economists to show that these are more vulnerable to criticism than any others having regard to the legal framework to which they must accommodate themselves. The Board have made the mistake of trying to justify themselves by the standards of the 'outworn economics of private enterprise'. Instead of getting credit for a

[33] Op. cit., page 30.
[34] But see the Postscript to this article.

praiseworthy attempt to reconcile the irreconcilable, they have only succeeded in providing a tasty meal for the likes of Mr. Dennison and myself.

POSTSCRIPT

The Editor has very kindly permitted me to comment on one important point of criticism which has been made of this article. The criticism is that the Board is *not* required by the Act to break even, i.e. it is only required to cover its costs on the average of years and this does not rule out the making of profits.

What the Act says is 'that the revenues of the Board shall not be less than sufficient for meeting all their outgoings properly chargeable to revenue account on an average of good and bad years'. This is quite consistent with what has been said in the previous paragraph. It is also consistent with breaking even, i.e. the pricing of coal so that, taking one year with another, both (overall) losses and profits should be avoided. What matters then is how the Act is being interpreted.

No one who followed the progress of the Nationalization Bill through Parliament can doubt that the latter interpretation was intended. The industry was not to become a charge on the taxpayer and the making of profits was immoral. It was realized that with the best will in the world the Board could not exactly balance its budget in each accounting period and so the words 'on an average of good and bad years' were included. It is true that the making of profits was not *ruled out*, but they would be regarded as a symptom of some abnormality. The normal pricing policy of the Board would necessarily be based on average costs.

Neither can there be much doubt that the Board interpret the Act in this way. By way of example we may quote paragraph 523 of the N.C.B. Report for 1947: 'The industry must, by virtue of the Nationalization Act, cover its costs taking good years with bad. But if, over a period of years, the industry as a whole is neither to incur a loss nor make large profits, individual pits, areas, or coalfields may do so.' The paragraph goes on to say that such losses and profits of individual pits or districts will suggest that the nation's resources are not being used to the best advantage and that corrective action should be taken. This is in agreement with the interpretation I have given, i.e. that prices must be based on overall average costs in order to break even in the short period though this implies profits and losses for individual pits and districts. In the long period, development will be concentrated on the 'profit areas' and effort

slackened in the 'loss areas' so that in long run equilibrium (which of course will never be reached) even the separate parts of the enterprise will break even.

I am considerably puzzled that any competent observer should deny this interpretation. For if further proof was needed it lies in the reiterated statements of the Board that when their new price policy is in full operation the delivered price of each class of coal in each zone will reflect the average cost of production of that class plus the average cost of transporting it, i.e. the only difference between the price paid for any grade by any two consumers will arise from the fact that they are in different consumption zones for which the average cost of transport differs. After paying transport costs the Board will receive in respect of each class of coal a price which reflects the average cost of producing it. Therefore total costs will just be covered by total proceeds and the general price level of coal will reflect its average cost of production.

I may appear to have laboured this point too much. I have done so because it appears to me to be vital to ascertain whether my interpretation is correct. The criticism comes from an eminent source and implies that the Board has more freedom in shaping its price policy than some of us have hitherto believed to be the case. The Act is vague and if the responsible Minister and the Board are changing their interpretation it is high time we were told. This applies no less to other nationalized industries. I have recently come across some startling interpretations of the break-even clause in another nationalized industry.

The point which I had not sufficiently appreciated when I wrote this article is the amount of freedom which the Board could win for itself by merely changing its interpretation of the break-even clause, i.e. without amending the Act. Indeed there seems to be no obvious *statutory* reason why the Board should not take the course which Mr. Dennison advocates.

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COMPETITION BETWEEN THE NATIONALIZED ELECTRICITY AND GAS INDUSTRIES[1]

by E. K. Hawkins

1. *Introduction.* In recent years there has been much discussion about the need for a national fuel policy, to co-ordinate the activities of the coal, electricity and gas industries of the United Kingdom. This has culminated in the report of the Ridley Committee on national fuel policy.

The demand for a national fuel policy has become insistent because of the continuous coal shortage that we have suffered since the end of the war. In general, it is felt that, as there seems to be no immediate hope of alleviating this shortage by increased production alone, then, at least, some conscious effort ought to be made to use these scarce resources in the most economical way. Given the continuance of full employment and barring spectacular technical progress, which, in any case, would take some years to put into practice, then the increase in coal production foreshadowed in the National Coal Board *Plan for Coal*, is far too small to permit the present state of affairs to continue. The British Electricity Authority anticipates increasing its own coal consumption by thirty million tons over the same period as the Coal Board plan; this represents a rate of growth of coal consumption of only seven per cent per annum, well below the B.E.A's rate of growth since nationalization. But the Coal Board expects to increase its production by only twenty million tons.

Whilst there may have been no explicit 'fuel policy' in the last few years there has been one implicitly through the way in which particular problems have been handled. This 'policy' consists of the rationing of coal and coke, whilst permitting the independent electricity and gas industries to compete freely against each other and against the controlled solid fuel industry. At the same time, capital investment has been controlled with encouragement to coal and electricity to invest as much as possible. It will be clear that the present 'policy' cannot last, given the relative growths of coal supplies and of the demand for coal for making electricity.

[1] This paper was read, in earlier versions, to Oxford graduate seminars in the spring of 1952. It owes much to the discussions that took place there and to the many writings on the subject, particularly those by Mr. H. S. Houthakker, referred to in the text, and Professor A. Lewis's *Overhead Costs*. I am also indebted to Professor Jewkes, Mr. P. W. S. Andrews and Mr. T. K. Gribbin for their comments on this paper. It has been revised to take note of *The report of the Committee on national policy for the use of fuel and power resources* (The Ridley Committee), Cmd. 8647, H.M.S.O., 1952, which has discussed aspects of the problem of competition between the two industries.

This paper is not concerned with the wider aspects of a national fuel policy, but it examines the policy, followed so far since nationalization, of unrestricted competition between independent electricity and gas industries. This has been explicitly recommended by the Ridley Committee who conclude that, '... the best pattern of fuel and power use will be promoted not by the direct intervention of the Government, but by the exercise of the consumers free choice of his fuel services — provided that competition between the fuel industries is based on prices, tariffs, and terms of supply which closely correspond to the relevant costs of supply, and that the consumer is enabled to make an informed choice.' (para. 232.)

The Committee makes recommendations which aim at bringing these conditions into effect, particularly with reference to electricity tariffs and to the charges to be made when extending supplies to new consumers. Is such competition between two statutory monopolies likely to lead to the best use of fuel supplies in the long run? The experience of the two industries since nationalization provides an interesting case study of such competition in a slightly different environment from the pre-war situation. The beginning of the war saw the end of a long period of continuous expansion for the electricity industry in which it had expanded its sales largely by increasing the number of consumers; the gas industry on the other hand was not expanding fast and was giving way to electricity in some fields; at the same time solid fuels were a cheap and abundant competitor to both manufactured fuels. After the war the situation was one of a rising demand for fuel as a result of full employment and domestic coal rationing. This has meant that competition between gas and electricity has become keener, the more so, since both industries are now organized on a regional and national basis, rather than on a local basis.

Three principal means of competition are employed. The most important (although the question of 'how important' will have to be discussed) is the use of tariff structures as a means of promoting sales. Secondly, an important way of increasing average sales per consumer is by the sales of electrical and gas appliances; unfortunately, published information on this subject is very sketchy. Finally, sales promotion activities, such as advertising, exhibitions, films, etc. have been used extensively. This kind of activity has traditionally been a feature of both industries, but it is difficult for an outsider to assess its influence.

2. *Measuring Efficiency.* (a) *thermal efficiencies.* Much recent discussion of the fuel and power problem has been in terms of thermal

efficiencies. In its raw state coal contains a certain amount of potential energy, although, of course, it varies considerably in thermal quality from one kind to another.[1] The coal consumed by gas and electricity production is transformed into other more useful forms of heat and power. During the conversion there is some loss of potential energy, and thermal efficiency ratios attempt to measure the success of the conversion. A similar thermal loss occurs when the fuel is used in an appliance, and this has to be considered as well.

Thermal efficiencies were first seriously considered in the 1945 Egerton Report on the *Heating and ventilation of buildings*,[2] where the thermal efficiency at the production stage is defined as: 'the ratio of the sum of the thermal values of the products sold for use external to the power station or gas works, to the potential heat in the coal consumed.'[4] The conclusions, based on 1937 data, were that the average efficiency of electricity generation (allowing for losses in transmission) was then 18 per cent, and that the average production efficiency for gas (similarly adjusted for gas unaccounted for) was 73 per cent. This figure includes the thermal value of all the by-products of gas production, particularly coke and tar. If account were taken only of the thermal value of the gas produced, the Egerton Report calculated that the production efficiency would be 48 per cent.

Discussion of the thermal efficiency ratios is continued at length in the report of the Ridley Committee and in the evidence submitted to it by the nationalized fuel industries. The Committee, in their own calculations, choose to depart in a significant way from the definition adopted by the Egerton Report. The efficiency of production is now defined as: '. . . the relation of the thermal output less the thermal content of any output consumed in the process to the thermal input less the thermal content of any marketable by-products.' (Appendix I, para. 5.)

This definition yields the following results for the year 1950-51:

Gas:	production efficiency	53.6 per cent
	distribution efficiency	90.3 per cent
	combined efficiency	48.4 per cent
Electricity:	production efficiency	22.2 per cent
	distribution efficiency	88.1 per cent
	combined efficiency	19.5 per cent

The new definition, when applied to gas production efficiency, is equivalent to the second approach adopted by the Egerton

[1] The coal used for electricity generation is not always suitable for gas production.
[2] *Post-war building studies, No. 19.* Ministry of Works, H.M.S.O. (London), 1945.
[4] Op. cit., page 51.

Committee, and assumes that all the thermal loss in production is borne by gas production, and that coke and other by-products are produced at 100 per cent efficiency. If the first approach of the Egerton Committee is followed instead a very different result is obtained (from the Ridley Report, Table A, p. 76.):

Thermal value of gas for sale to the public by the Area Gas Boards:	2659.9 million therms
+ Thermal value of by-products	3561.1
TOTAL thermal output	6221.0 million therms
Thermal value of fuel consumed:—	8527.3 million therms

$$\text{Gas production efficiency} = \frac{6221.0}{8527.3} \times 100 = 73 \text{ per cent}$$

(b) *financial measurements.* The above percentages are input–output ratios in real terms; the economist, however, is also interested in the financial results and it is therefore of interest to calculate financial input-output ratios in order to see how they compare with the technical ratios. The Ridley Committee's own arguments suggest such a comparison, for they argue (Appendix I, para. 4) that, 'Although some by-products may not be used for thermal purposes that is normally *because they are of greater value in other uses. . . .*'[8]

The following financial input-output ratios for fuel have been constructed following, as far as possible, the Ridley Committee's own sources:

Gas 1950-51

Value of gas for sale to the public (at 13.00 pence per therm sold):	£143.6 million
By-products:	
Value of coke and coke breeze	49.5 ,,
Value of tar and tar products	9.3 ,,
Value of Benzole	2.8 ,,
	£61.6 ,,
Fuel used:	
Value of coal (including 'expenses thereon')	£86.2 million
,, ,, gas oil used	6.8 ,,
,, ,, electricity used	0.6 ,,
,, ,, gas purchased	4.1 ,,
	£97.7 ,,

[8] In view of this passage it is difficult to see why tar is included but benzole excluded from the calculation, unless it is that the latter has no technical thermal equivalent.

(a) Ridley Report Method (Table A, p. 76)

$$\frac{143.6}{97.7—61.6} = 1 : 3.98$$

(b) Alternative method

$$\frac{205.2}{97.7} = 1 : 2.1$$

Electricity 1950-51 (*B.E.A. only*)

Electricity sent out (at 1.19d per kwh):	£251 million
Value of fuel used (including handling etc.)	90.4 „

Ridley Report method (Table C, p. 78)

$$\frac{251}{90.4} = 1 : 2.78$$

It will be seen that there is a big difference between the financial ratio for electricity and that for gas, using method (a), but a much smaller difference when the ratio for gas is calculated by the alternative method. It is also interesting to see that method (b) gives a lower financial ratio for gas than when the Ridley report method (a) is used, the reverse of what happens with the technical ratios given on p. 157-8. The reason for this is that whilst the output of by-products in therms is larger than the output of gas in therms, the sale value of these by-products is much less than that of gas, so that the financial ratio is lower than the ratio which takes account only of thermal values.

The Ridley Committee method for gas is not a true input-output ratio, but a composite ratio, for an output appears in the denominator as well as in the numerator. It is therefore suggested that their method does not give a legitimate comparison with electricity production efficiency, which is a true input-output ratio.

The financial ratios attempt to show the financial side of the technical conversion ratios. They depend, therefore, on prices and costs, and are incomplete in themselves in that they deal with the input of only one factor of production, albeit the most important. However, the financial outputs are based on the market value of the thermal products, which will depend in turn on their prices. These prices are based on an average cost analysis (at least for gas and electricity) which will include the costs of inputs of other factors of production besides coal. The dominant factor, therefore, is the relationship between the prices of gas and electricity. The financial ratios are very close to each other because electricity, when placed on a comparable thermal basis, is much more expensive than gas; this

has the effect of increasing the size of the numerator of the electricity ratio. This influence can be demonstrated more clearly in terms of the net output analysis given below.

Technical efficiency ratios were first applied to the problems of fuel policy in the Simon report on *Domestic Fuel Policy*.[1] This advocated a policy which would encourage the use of solid fuel, particularly coke and anthracite, for space heating and water heating leaving electricity and gas to deal on a competitive basis with lighting, cooking and power.

The economist is interested in these technical efficiency ratios because they will be one factor, perhaps an important one, in the competitive relationships between gas and electricity. If all other things were equal, then we would expect the costs and prices of the two fuels to reflect differences in technical efficiency (if prices are based solely on costs of production). In actuality these factors are very different, but it is interesting to compare the relative net output of the two industries with the relative production efficiencies. As net outputs depend on market values, this again brings in the relative prices of the two fuels. Direct comparisons of relative prices, because of the difference in the tariff structures, would not be very helpful in this connection.

The production efficiency ratio, corrected for efficiency in distribution, of electricity to gas is 1 : 3, (i.e. 19.5 to 65.9 per cent). The ratio of the net outputs can be derived as follows for 1948 and 1949, for which net output figures are currently available: (The coal consumption figures are adjusted for the thermal efficiency of production, in terms of potential power delivered to the consumer.)

	1948	1949
1. Gas, coal consumed	24.6 million tons	25.3 million tons
2. Electricity, coal consumed	28.8 „ „	30.0 „ „
Corrected for efficiency in production and distribution		
3. Gas (65.9 per cent)	16.2 „ „	16.7 „ „
4. Electricity (19.5 per cent)	5.6 „ „	5.9 „ „
Net Outputs (£ million)		
5. Gas	£81.6 million	£82.3 million
6. Electricity	133.3 million	147.6 million
Net output per therm of potential power delivered to consumer (i.e. 3 and 4 converted to therms at the conventional figure of 300 therms per ton and divided into 5 and 6)		
7. Gas	4d. per therm	4d. per therm
8. Electricity	19d. „ „	20d. „ „

[1] Cmd. 6762, H.M.S.O. (London), 1946.

In lines 7 and 8 are shown the net output of the two industries per therm of power delivered to the consumer. The striking thing about these figures is the big difference between the two; this is because the net output figures depend on the prices of the products, (as we saw on p. 159 this also accounts for the fact that the financial input-output ratios are so close together) and the average price of electricity per unit is much higher than for gas. It is therefore interesting to see that, as the prices of the fuels are calculated on their costs, the higher efficiency and hence lower cost of gas production is reflected in gas prices. The ratios of 8 : 7 are:

1948: 1 : 0.21 1949: 1 : 0.20

These revenue ratios, as they might be called, are roughly the inverse of the 1 : 3 production efficiency ratios. They do not correspond exactly because the net outputs are arrived at by including other fuels besides coal as costs, and also by including the considerable revenue received by the gas industry from the sale of by-products (itself a reflection of the higher efficiency of gas in production); one must also take into account the fact that about 12 per cent of all gas available is purchased by the gas boards from coke ovens to whom it is a by-product. For these reasons, the inverse of these revenue ratios exceeds the production efficiency ratios. (It will be appreciated that the above calculation is a very crude one and can indicate only relative orders of magnitude.)

Economists are entitled to ask how far arguments on a national fuel policy which use these technical efficiency ratios are valid. It is interesting to find indications, as above, that the relative prices of the two fuels do reflect, to some extent, the opportunity costs to the community of using the same primary fuels in two different ways. Of much more interest and importance in the long run, however, are the economic factors such as the long run trend of demand, how that is influenced by tariffs, the investment policies pursued and the sales policies of the two public monopolies. It is here that the question of competition becomes very important, for the present policy of giving the consumer freedom of choice will be justified only if the use of coal, gas and electricity corresponds to social costs.

3. *Competition — a theoretical case.* Before considering the actual state of competition between electricity and gas, it is worth while looking at the theoretical case for unrestricted competition between two monopolies, selling products derived from a third common source. Let us assume that the gas and electricity industries buy coal (of which, it is assumed, only one kind is produced) which is also on sale to the public for direct use as fuel. Thus, for space heating,

water heating and other uses where direct heat is required, all three fuels compete; for lighting purposes electricity and gas compete. (Let us assume, for the moment, that the fact that each fuel must be used in a suitable appliance makes no difference to the argument.)

Coal is assumed to be available to all consumers at one price, including the gas and electricity industries, and since the latter two fuels must be manufactured, their costs exceed that of coal (the cost of electricity exceeding the cost of gas). Coal is produced under conditions of increasing cost, and electricity and gas probably under decreasing cost conditions,[7] at least for a wide range of outputs.

As for demand conditions, it is difficult to say what is the most realistic assumption to adopt. There is little empirical evidence as to the elasticity of demand for fuel and power but it is known that expenditure on gas and electricity forms a small proportion of the costs of all but a few industries, whilst coal may be an important item. Similarly, from 1946-51 personal expenditure on coal, electricity and gas (at 1948 prices) averaged only 4.0 per cent of total personal expenditure on consumer goods and services, of which about 1.0 per cent each was spent on gas and electricity, and about 2.0 per cent on coal[8] (although it must be remembered that coal was rationed to the domestic consumer during this period). These figures suggest that the true elasticities are fairly low, and Houthakker's statistical analysis of the pre-war demand for electricity bears this out.[9] It will therefore be assumed throughout this paper that the demand for gas and electricity is inelastic, and that the demand for coal is also inelastic, although less so than for the other two fuels.

To return to the theoretical model, it will be seen that, under the conditions assumed, coal is the cheapest fuel for a large variety of uses and the demand for coal may rise. There are two possible price policies that can be considered here; one is that all three industries attempt to maximize their net revenues, or secondly, that they base their prices on average total cost and aim to make no profit. If the demand for coal rises, in the first case, the price of coal will rise to an extent depending on the elasticity of demand in the new situation and there will then be an incentive to increase production. However, increased coal production will result in higher costs of

[7] See a (forthcoming) article by T. K. Gribbin in *Oxford Economic Papers*—'Costs of production in the Gas Industry'—which gives evidence that this is so for gas, up to a certain range of output. H. S. Houthakker has argued that economies of scale are important for electricity also up to a point ('Electricity Tariffs in theory and practice', *Economic Journal*, March 1951, page 9).

[8] *National Income and Expenditure, 1946-51* (H.M.S.O.), 1952, Table 16.

[9] H. S. Houthakker—'Some calculations on electricity consumption in Great Britain', *Journal of the Royal Statistical Society, Series A (General)*, Vol. CXIV, Part III, 1951.

coal, so that there is a second reason why the price of coal should rise, and prices should rise whatever price policy is adopted for coal.

This rise in the price of coal will affect the cost of gas and electricity to an amount depending upon the proportion of their costs that is taken up by coal. However, it will affect the cost of electricity proportionately more than gas because coal makes up about 85 per cent of the gross cost of production of electricity and 70 per cent of the gross cost of making gas. These changes will affect their prices, under the first assumption about prices, to an extent again dependent upon the elasticity of demand; under the second assumption, prices will be directly affected by the change in costs. The effect of all this will be to change the relative average prices of the three fuels slightly in favour of gas.

However, gas and electricity are large consumers of coal — large enough to influence its price by their demands. A change in relative prices in favour of gas, if it increases the demand for gas, will tend to raise that industry's demand for fuel and hence the price of coal. This, in turn will raise the costs and price of electricity (as it will those of gas), but again, because of the differing proportions of the cost of coal in total costs, the costs of gas will be raised proportionately less than the costs of electricity. Thus the net result is, again, to change relative prices in favour of gas. The same would be true of an increase in the demand for electricity which increased its demand for coal.

It will be obvious that, even in the very simple form that has been used so far, this is an extremely complicated theoretical model, for it contains several inter-related variables; it is, in fact, an example of 'tri-lateral' monopoly, which it is not the purpose of this article to solve. However, it is possible to see that there is a general tendency for relative prices, especially when they are based on average costs, to move in favour of gas and against electricity, with coal remaining cheaper than them both. The theoretical analysis suggests that, in the event of unrestricted competition between the three monopolies, prices will tend to reflect the true relative opportunity costs of using coal.

4. *Competition in practice — limitations to the theoretical model.* There are several qualifications to our simple model which are required to take account of features of the real world which modify this conclusion.

The most important qualification and the one which particularly vitiates present-day arguments in favour of unrestricted competition, is the proviso that the responses by the three industries to changes in

demand depend on the freedom to invest as, and when, required. It is well known that the control of investment exercised in this country prevents this, although in the case of electricity and coal, this control has been exercised in their favour. However, there are reasons for believing that in the case of all three industries investment has been limited more by specific shortages rather than by controls.[10] Even in the gas industry, where investment has been restricted by controls, the shortage of cast iron pipes has reduced investment further.[11] The combined effect of these two influences in reducing investment means that production cannot expand in response to increases in demand. Where prices are based on costs, as they are, this will mean unsatisfied effective demand, rather than higher prices.

The second qualification to the model is that it is by no means certain that demand is sufficiently responsive to price changes to ensure that changes in relative prices will bring about the allocation of resources required. The evidence on this account is very sparse and will be reviewed below. If the elasticities are as small as the evidence indicates, the case for relying on the price mechanism by itself as a method of allocating resources amongst the two main users of coal is much impaired.

The model also assumes that coal is a homogeneous commodity, being sold at a standard price, and that there are no transport costs. The situation in practice is that there are different types of coal and that the price to the electricity and gas industries will not be the same as they often use different qualities. Similarly transport costs are very important. The effect of both these qualifications is to make the interactions between the prices of the three fuels more complex without altering the basic principles. The high transport costs, for example, causing large differences in the price of coal between regions, effectively destroy the possibility of a uniform national price for gas and electricity, whilst prices are based on costs to the consumer.

Another factor about which little is known is the relationship between the cost of gas and the demand for the by-products of its production, of which coke and tar are the most important. The cost of gas depends partly on the net cost of coal — that is, on the gross cost minus the value of the by-products. The higher the latter, the lower the net cost of gas; yet not only is the output of gas and coke interchangeable within limits in production (the yield of gas can be increased at the expense of the output of coke), but they are also

[10] Cf. *The Economist*, June 30th, 1951, p. 1584.
[11] Gas Council, 2nd report and accounts, para. 136.

competitors over a range of services — space heating, water heating and, to some extent, cooking. Thus the price of coke represents a further variable that should be added to the three others discussed above. So little information has been published about this, that it will not be pursued here.[12]

Finally the model ignores the important point that all three fuels must be used in appliances, which are normally relatively expensive consumers' capital goods. They are not of a uniform age and kind, and the efficiency of the fuel to the consumer is closely linked with the age and quality of the appliance. The hire and sale of them opens up an important field of competition between the industries.

5. *Tariff structures.* The element of competition between the industries on which attention has been focused since the war has been the tariff structures of the two industries. The problem of the right kind of tariff will not be discussed as it has been comprehensively dealt with in the literature.[13] Following these writings one may distinguish four categories of costs that are important for tariff construction: (*a*) Energy costs, which are those costs which vary directly with the actual output. For electricity they are the average works cost of generation and for gas the average prime cost 'into holder'. (*b*) Capacity costs. These are the costs of the capacity required to produce and distribute the maximum demand expected at the peak. The tariff problem turns on the way in which these costs are recovered. (*c*) Consumer costs, or the costs of supplying each particular consumer. These can be unambiguously determined, for they are the cost of wiring, metering and connecting the consumer to the nearest main or cable. The method by which these costs are borne is of importance to the state of competition between the industries because an important method of extending sales is by adding to the number of new consumers.

There are marked seasonal and daily swings in the demand for gas and electricity which give rise to the peak load problem. The ratio of capital to turnover is very high and sufficient capital must be used to supply the peak demand when it occurs. For gas, one may split the capacity costs into two parts, which can conveniently be called production capacity costs and distribution capacity costs. This recognizes the fact that gas can be stored and the production capacity costs depend on the total maximum demand over any twenty-four hour period. However, the distribution system must be

[12] See, however, T. K. Gribbin, op. cit.

[13] See especially H. S. Houthakker—'Electricity tariffs in theory and practice', *Economic Journal*, March 1951.
Also—*The Economist*, June 14th and 21st, 1952, page 762 and page 834.

adequate to deal with the maximum demand at any one moment and the costs of this are the distribution capacity costs. It is usual to measure these over the period of the heaviest hour's demand in the twenty-four.

Electricity cannot be stored and the daily peak or peaks are of over-riding importance. It is obvious that electricity or gas produced at off-peak periods is less costly than that produced at the peak because the equipment is under-utilized at these off-peak times. As Mr. Little has expressed it, seven o'clock electricity is a different commodity to eight o'clock electricity.[14]

The tariffs of both industries have been traditionally based on costs and this has now been re-inforced by the requirement of the nationalization acts that the industries should cover their total costs.

The analysis of costs given above into three (or four) categories, (to which must be added a further general class of miscellaneous overhead costs), leads logically to some form of multi-part tariff as the 'ideal tariff'. In that way the parts can be arranged to cover each different category of costs. For electricity, a fixed charge could cover the consumer costs (differing for each consumer), the overheads and the consumers' share of capacity costs. In the case of gas, a three part tariff would be necessary with one standing charge based on production capacity costs (based on the consumer's share of annual peak daily demand) and a second based on the consumer's share of the distribution capacity costs. Finally, for both services the running charge part of the tariff would be based on the average variable costs of production of the fuel. Thus a tariff would result in which the average cost per unit of the fuel used to the consumer would fall both as his consumption increased and as his share of capacity costs at the peak fell. Such a tariff, in other words, would improve the utilization of the capital employed in producing and distributing the fuels.

This 'ideal tariff' is based on the implicit judgment that it is right to discriminate between consumers and charge each of them the costs incurred by supplying them. Also, it ignores the problem of what is to happen if the average price per unit as determined by this 'cost of production' pricing method is below the price at which demand equals supply. Should this happen, the excess demand will exert a pressure on the industry, encouraging a rapid rate of investment, the capital charges of which will be borne by the standing charge in the tariff.[15] This possibility seems to be the weakness of

[14] I. M. D. Little, 'Electricity tariffs—a comment', *Economic Journal*, December 1951, page 875.

[15] This problem has been fully discussed by Mr. Little, op. cit., page 880.

the recommendations of the Ridley Committee, which are based on the assumption that 'cost of production pricing' will approximate to those prices which will equate effective demand and supply.

The historical development of the gas and electricity industries in this country has been such that, by nationalization, the two-part tariff had become very common for electricity, but, for political reasons, the gas industry had been unable to develop such tariffs.[16] The first report and accounts of the British Electricity Authority (1949) show that, on the eve of nationalization, 57 per cent of domestic consumers were on a form of two-part tariff, whilst another 11 per cent were on a variable block tariff.[17] This latter was the form of promotional tariff that the gas industry had begun to use and under this tariff the average cost per unit falls for successive blocks of consumption.

A tariff structure is more than a means of covering costs adequately; as it is promotional it is a powerful weapon of competition. This was recognized by the report of the Committee of Inquiry into the Gas Industry (The Heyworth Committee) which found that: 'There is ample evidence that the efforts of the gas industry to adapt its price policy to new conditions have been largely dictated by the competition from electricity. . . .'[18]

The 'ideal tariff' would ensure that the price to each consumer reflected the costs involved in supplying him. The actual situation that has developed is that the relative prices facing the consumer do not reflect these costs, and consequently competition between the industries for this and other reasons does not fulfil the function of allocating resources on the basis of consumers' choice and opportunity costs. There are two sets of arguments that support this view; one set is concerned with the evidence that suggests that the tariffs do not adequately reflect the costs involved; the second set goes further and questions the relevance of relative prices as being important determinants of relative consumption.

Since nationalization the electricity and gas industries have begun to unify their tariff structures over the whole country; they have, however, adopted structures that broadly continue the old differences between the two — electricity will soon be sold almost universally on a type of two-part tariff (which is in the form of a variable block tariff) and gas on a block tariff. These new tariffs show the same characteristics as the old and are open to the same criticisms.

Both industries, according to their annual reports, considered the

[16] See Professor A. Lewis's discussion in *Overhead Costs*, page 68.
[17] B.E.A. 1st Report and Accounts (1949), page 295.
[18] Cmd. 6699, H.M.S.O., 1945, page 24.

advisability of a uniform price for the whole country. The idea seems to have been abandoned on competitive grounds (see, for example, the discussion on the B.E.A.'s tariff for the area boards — 1st Report, 1949, p. 58), but the Gas Council report that a standard tariff has been introduced into an area board which has a gas grid supplying gas from several works. They justify this on the grounds that: 'the grid means, in effect that production is pooled and that it is impossible to say from which works any particular consumer gets his gas at any particular time.' (Gas Council 2nd report, 1950, p. 55.) Quite obviously, however, differing distribution costs would justify discrimination between different consumers in prices. To charge a standard price implicitly involves a judgment that some consumers should get a service at less than its cost, whilst others pay more than its cost. To quote from the Gas Council's 1st Report (1949) p. 83: 'There are also considerations of social policy, less ponderable, but not the less real, which bear on the question of the uniformity of prices: and these lie beyond the scope of the present report.' It is suggested that it is just such imponderables of social policy that ought to be within the scope of a nationalized industry.

The electricity industry's new tariff for domestic consumers is a variable block tariff with two blocks; the first block has a high charge per unit for current, and the number of units which come under this block is determined by the number of rooms in the premises. All subsequent units of current used are charged at a very low price. The tariff is, in effect, a concealed two-part tariff with a 'standing charge' (the minimum number of units at the high price) based on the size of the house. As a method of covering consumer costs, a share of overhead costs and the share of the capacity costs at the peak period this is obviously a crude method. The size of the house or apartment is correlated not with these but with income levels. This is simply a method of discriminating between consumers on the grounds of income. Mr. Houthakker has argued[18] that this discrimination was so important in pre-war days that only the running charge at the low price is relevant for competition at the margin of substitution between gas and electricity. The gas industry was conscious of this last effect and it was discussed in the Simon Report of 1946 (Appendix IV). The Heyworth Committee found that: 'The differential in cost which gas now enjoys over electricity is difficult to evaluate, but the over-all figure is probably not more than 15 per cent.' (para. 136, p. 25.)

[18] H. S. Houthakker, op. cit., *Journal of the Royal Statistical Society, Series A (General)*, 1951, page 359.

This particular figure is difficult to substantiate under the new tariff structures. A calculation, based on two tariffs used by electricity and gas boards competing in the same area gives a rough indication of the present differential in prices.

The tariffs are as follows:

Electricity, Domestic:

(*a*) 4d. for each unit in a first block assessed as follows:
3 rooms or less — 30 units per quarter.
Each extra room — 9 units per quarter.

(*b*) 0.875d. for each unit in excess of the first block.

Gas, Domestic:

1st	30 therms	1s. 7d. a therm.
next	30 „	1s. 5½d. „
over	60 „	1s. 2¾d. „

The comparison is made for a winter quarter and for an assumed consumption of 40 therms of gas and 400 kwh of electricity. (kwh can be converted into therms at the ratio of 1 therm = 29.3 kwh.) It is also assumed that the house consists of seven rooms: 3 bedrooms, 2 living rooms, kitchen and bathroom (the latter two are not assessed for the electricity tariff). The average cost per unit for electricity works out at 1.32d. which is equivalent to 39d. a therm. The average price per therm for gas is 19d. and the differential is 51 per cent. However, if one takes the marginal price for electricity at 0.875d. a unit, it is equivalent to 26d. a therm, and the differential is reduced to 30 per cent. The Heyworth Committee's estimate therefore seems to be a conservative one.

Neither of the two tariffs is based on an attempt to cover the cost categories analysed above. Whilst there are technical difficulties in measuring the production and distribution capacity costs, a simple way of obtaining basic information on this subject is the method of conducting studies of the load characteristics of consumers by sampling, and it has been used extensively by the fuel and power industries in the United States. A sample of consumers is chosen and to their meters are fitted recording devices which record their consumption for each hour of the day. From these records the times of the maximum instantaneous demand on the distribution and production system can be discovered and analysed by types of consumers. In the case of domestic consumers the important factors would be the holdings of various combinations of appliances and the size of the household. For commercial and industrial consumers the type of business would probably be the most important factor. This information would assist in the construction of a tariff nearer to the 'ideal' because, if information as to a consumer's holdings of

appliances were known, then some attempt could be made to recover from him the share of the capacity and distribution costs to which he gives rise. This sampling method would save some of the cost of fitting 'time of day' meters to all consumers.

The weakness of the new electricity variable block tariff — that the standing charge is correlated with size of house and hence with incomes — is made worse from the view-point of competition with gas by the fact that the consumption of gas and electricity rises as income rises. Reasons were given above (p. 162) for thinking that the elasticity of demand for gas and electricity was low. The evidence on this is scanty. The Social Survey, for example, found, when they investigated the use of appliances in 1948-49, that the consumption of gas and electricity tends to rise as household income rises.[20] There are no comprehensive econometric demand studies for both gas and electricity but Mr. H. S. Houthakker's study of the demand for electricity under a two part tariff in the United Kingdom before the war suggests, on the basis of the data available, that the income elasticity is more important than the price elasticity (which here refers to the marginal price of electricity under the two part tariff) and that the price of gas is not an important variable affecting the consumption of electricity.

These indications give rise to the question whether free competition based on tariff structures and with free consumer choice will be at all effective in allocating scarce resources in an economic way. The case for competition depends on the differences in relative prices being significant at the margin of consumption, when taken into consideration with other factors, such as convenience, the quality of the service offered, etc. Apart from the lack of freedom of investment already discussed, the most formidable objection to the case for competition lies in the difference between the tariff types. The situation might be different if both fuels were sold on tariffs based on identical principles, but there is no information by which this supposition could be checked. There is *prima facie* evidence that the two-part tariff or the new variable block tariff described above for electricity minimizes the effect of the high average price per unit over the earlier ranges of consumption by correlating the standing charge or the size of the first block to an income scale. The effect is to discriminate and charge high average prices for the comparatively costly lighting load in which the competition of gas is negligible; lower average prices are then offered for extra heating loads which is where gas can compete with a service that gives a

[20] Social Survey report N.S. 130 (c), *Domestic utilisation of heating appliances and expenditures on fuels in 1948-49.*

much more efficient use of fuel in terms of primary fuels required to produce the gas.

6. *Appliances.* The use of electricity and gas requires an appropriate appliance and the extension of their sales proceeds as much by the sale of appliances (which increases average sales per consumer) as by the growth of consumption through new consumers. Both the industries have a big interest in the sale of appliances and, whilst electrical appliances are sold both by the Authority and a large number of private firms, the majority of gas appliances are sold by the gas boards, particularly cookers. From a financial point of view this service forms an important part of the industries' activities. The following table[11] shows their place in the 1950-51 accounts.

	Gas (£ million)	*Electricity* (£ million)
1. Sales	133.3	229.2
2. Sales of Appliances etc.		
(*a*) Cash and Credit	8.9	16.7
(*b*) Hire purchase	14.6	9.7
Total	23.5	26.4
3. Total costs	22.2	25.3
4. Net Income	1.3	1.1
5. 4 as per cent of Total sales of appliances	5.5 per cent	4.2 per cent

It will be seen that their financial importance is apparently approximately the same for both industries. The value of sales represents 18 per cent of the figure for total sales of gas and 12 per cent of that for total sales of electricity. However, if it is compared with the value of domestic sales (for the appliances concerned are mostly sold for domestic and commercial purposes) it is equivalent to 27 per cent of domestic sales of gas and 39 per cent of domestic electricity sales. Thus this side activity of the two nationalized industries has become an important one in terms of revenue and also in terms of increasing the sales of gas and electricity. There is no evidence available which enables one to assess how important this latter aspect has become. It will depend on the net increase in holdings of appliances, the number of appliances hired and other unpublished factors. It is interesting to note the difference between the proportions of sales of appliances sold under hire purchase arrangements in the two industries; the gas industry gets 62 per cent of its revenue from appliances by this means, but the electricity obtains only 37 per cent.

[11] Source: Gas Council, 2nd report, App. III; B.E.A. 3rd report, Statement A.6.

7. *The Ridley Committee's recommendations.* The policy of allowing unrestricted competition between gas and electricity, whilst co-ordinating them as far as possible in other respects, has now been endorsed by the Ridley Committee. It is doubtful, however, on the evidence at present available to the student, whether this policy will be at all effective in altering the present pattern of consumption.

Since 1946 the pattern of consumption of gas and electricity has changed; the proportion of total gas sold to domestic consumers has fallen from 65 per cent to 60 per cent and the percentage of total sales going to industrial consumers has increased. On the other hand the proportion of total electricity sales going to domestic consumers has increased. This change in consumption habits has been the result of the policy of unrestricted competition and of the rationing of coal.

The tariff changes proposed by the Committee would make electricity prices more in accordance with the concept of the 'ideal tariff', based on average production costs which was discussed above. Whilst electricity tariffs continue to be based on marginal prices at the margin of substitution for gas, and gas prices are based on average prices, it is likely that the proposed change will not make much difference to the pattern of consumption.

The proposals as to the charges to be made for the connection of new consumers to the system, if adopted, may make a bigger difference. As most of the new housing since the war has been for local authorities, the decision as to whether both gas and electricity should be put into new houses depends not on the consumer's choice but on the choice of the authority. In these circumstances it is difficult to get information on the basis on which these choices were made. The Ridley Committee has given some information on this subject and shows that some Boards have been 'discriminating in their connection charges they make on the basis of prospective consumption, rather than by reference to the actual costs' (Appendix X, p. 109). The Committee recommends that the normal costs of street and service mains be treated as an overhead to be recovered 'in either the standing charge of a two-part tariff or the first block in a block rate' (p. 110). Where heavier charges are incurred a special capital charge is to be levied on the consumer or builder. This places the cost on all gas and electricity consumers and would prevent discrimination between consumers. Thus this proposal will have some effect on consumers' choice in the long run, in so far as new housing adds to the number of new consumers.

The arguments of this paper have been based largely on static analysis, but many of the factors of the present situation are dynamic

The problem itself has arisen because of the rate of growth of the demand for secondary fuels compared with the rate of growth of coal production. Since the position of gas was first challenged by the growth of electricity, the method of unrestricted competition between the two, within the framework of some form of statutory monopoly, has been the way in which secondary fuels have been supplied. It would be interesting to know how far this competition has made for more effective use of capital in the two industries than if the competition had not existed. One justification for the Ridley Committee's recommendation of competition would be that it might make for a better investment policy and a more careful use of capital by the two industries. On the other hand, this would have to be weighed against the possibility (assuming that investment policies were not controlled) that much capital might be used in providing duplicated services. Unfortunately the information[23] for a full assessment of such dynamic factors does not seem to be available at the present time, but there is no doubt that it is these unknown factors that will be very important in the long run.

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[23] One result of nationalization that the student must regret is the reduction in the amount of published information available about the two industries. For example, the annual returns of the gas industry published by the Board of Trade have not been continued by the Gas Council. These gave information by separate undertakings, whereas only national and area information is now published. Another feature of the published information that could be remedied is the difference between the amount of information available about the gas industry compared with that published about the electricity industry. A glance at the *Statistical Digest* of the Ministry of Fuel and Power or at the *Reports* of nationalized industries will show that much less data is available for the gas industry than for electricity.

PUBLICATIONS RECEIVED

The American Economic Review, December 1952, Vol. XLII, No. 5, and March 1953, Vol. XLIII, No. 1.

Bradford's Survey and Directory of Marketing Research Agencies in the United States and the World, by Ernest S. Bradford, New York, 5th edition 1951-52.

The Controller, U.S.A., January, February and March 1953.

The Cost Accountant, the official Journal of the Institute of Cost and Works Accountants, London, Vol. 31, Nos. 8, 9, 10, January, February and March 1953.

Explorations in Entrepreneurial History, Research Center in Entrepreneurial History, Harvard University, Vol. V, No. 1, October 1952, and No. 2, January 1953.

Fellowship in Management Accountancy, statement by the Institute of Cost and Works Accountants, London.

Journal of the American Statistical Association, December 1952, Vol. 47, No. 260, and March 1953, Vol. 48, No. 261.

The Management Review, American Management Association, January and February 1953.

The Southern Economic Journal, a joint publication of the Southern Economic Association and the University of North Carolina, January 1953, Vol. XIX, No. 3.

OPERATIONAL RESEARCH — A NEW TOOL FOR MANAGEMENT[1]

by I. S. Lloyd

Most papers on the subject of Operational Research seem to have difficulty in finding a definition which satisfies their authors' concept of the technique they are trying to describe. They are usually concerned to prove that Operational Research is unique and important while disavowing any claim that it employs any methods, technique or apparatus with which the research worker in the natural or social sciences, or for that matter in the industrial research laboratory, is unfamiliar. They also take pains to indicate that Operational Research does not poach, or wish to poach, on the preserves of the specialized research worker in any field. It is not concerned, *per se*, with the improvement of processes or products, or with the development of new techniques. One definition which is often quoted with approval is the following:

> Operational Research is a scientific method of providing Executive Departments with a quantitative basis for decisions regarding the operations under their control.

This definition brings out several points. Operational Research is firstly 'a scientific method'. The Operational Research department when presented with a problem asks:

(1) On what basis have decisions in this sphere been made in the past? What information has been employed? What assumptions have been made overtly, and by implication, in reaching the decisions?
(2) Have all the variables which in fact affect the operations or their outcome been considered? Has their significance been correctly assessed? Are these variables in any way interdependent and is this interdependence known?

If the answer to the above questions indicates that the solution to the problem will depend on isolating variables whose significance is

[1] This paper is based almost entirely on a survey carried out by the author in Britain in the summer of 1951. Although it is based on discussions with a variety of individuals in government and industry the author is obviously solely responsible for any views which are expressed. It is also more than likely that there have been new developments in some of the organizations which are mentioned, as well as in other firms and industries which have established Operational Research groups.

unknown and has not been suspected, or on obtaining the information which will make it possible to fit parameters to variables which are known but whose significance has not been assessed quantitatively, then the Operational Research group will consider whether this can be done and what methods of observation and analysis must be employed.

The nature of the problem and the information which is already available generally determine the methods employed in its solution. In some cases the solution will be obtained by a reorganization and analysis of existing information. In other cases fresh information will have to be obtained and in yet other cases a careful study of the whole environment of the problem will be necessary before it can be discovered whether it is amenable to analysis by any known method of logical thought and whether the necessary information can be obtained without disrupting in any way the operations in progress.

This is essentially the scientific attitude and what is new about Operational Research is not the scientific attitude, or the tools which the scientist has developed to answer the questions he asks, but the focusing of this attitude and the use of these methods in solving the complex problems of organization and operations, firstly in the military and now in the industrial sphere. The executive is always conscious of limiting factors which affect his decisions. Sometimes he is fully conscious of their collective importance without necessarily being able to assess their individual weight and influence. At other times he is unable even to isolate the factors. In spheres where these factors have an important effect on the outcome of operations, decisions are based on an intuitive judgment of their significance which is generally described as 'experience'. Experience is the essential substitute for knowledge where the latter does not or cannot exist; it is the ability to assess the limits of the unknown which comes of a long familiarity with the unknown. The function of Operational Research is to substitute knowledge for experience wherever it is both important and possible to do so, to discover, isolate and measure the limiting factors and thereby to enable the executive to base his decisions on a firm foundation of fact and knowledge. The aim of the Operational Research group is to ensure that wherever an assessment of probabilities is involved in the process of decision-making, this assessment will be based on a thorough statistical appraisal of the various known and unknown factors which should be considered.

In the case of the Post Office, for example, it was generally believed that the regular maintenance of telephone cables limited the rate of failure. An Operational Research investigation of past failures in relation to the maintenance work carried out proved that

this was not the case since there was no correlation between maintenance and the absence of failures. It was found that a cable was just as likely to fail immediately after maintenance as immediately before it. The causes of cable failure were not related in any statistically ascertainable manner to the type of work done in the course of normal maintenance. This investigation resulted in a reorganization of cable maintenance since there was obviously nothing to be gained from the existing methods of regular maintenance. Such methods may, of course, serve other purposes but, in view of these results, the work can now be directly oriented towards these purposes. The problem of failure will have to be tackled afresh along other lines.

Another example of the importance of unknown factors is the discovery by an Operational Research group of the Ministry of Civil Aviation that the main factor limiting the aircraft-handling capacity of Heathrow was not the size of the aerodrome or the number of the runways, as might be expected, but the capacity of the main trunk road system to handle the additional volume of road traffic which was involved. This result was obtained from a careful investigation of the number of road vehicle movements to and from the airport which was involved by the arrival of an aircraft.

One of the best examples of the way in which the use of the wrong criterion can limit the effective use of resources occurred in Coastal Command during the war. An Operational Research group, at a critical stage in the U-Boat war, was given the task of studying the low utilization of aircraft in this command. Observation of the way in which operations were conducted soon enabled the group to discover that the criterion of serviceability employed was in fact *preventing* full use of the command's resources being made. The criterion then being used was the proportion of aircraft serviceable — either flying or ready to fly. This is a sound criterion only at the outbreak of a war, when a maximum *immediate* effort may be required, but when a maximum *continuing* effort is required a different criterion must be used. A calculation can be made for any type of aircraft showing the number of hours it will have to spend on the ground for service, maintenance and overhaul for each hour in the air. If this is a ratio of 2:1, for example, then the maximum *continuous* effort can be achieved by flying only a third of the aircraft. These conditions determine a serviceability of 33⅓ per cent, a figure which can be improved upon only by keeping serviceable aircraft on the ground. The trial application of these results to an operational squadron enabled the squadron to achieve a record number of flying hours and the final result was the application to the whole command of a form of statistical control known as 'Planned Flying — Planned

Maintenance' which permitted an improvement in the utilization of resources, measured in flying hours per maintenance-man employed, of the order of 60 per cent.[2] The conclusions of the recent report of the Anglo-American Council on Productivity on Plant Maintenance indicates that there are many maintenance problems in industry which would repay the attention of an Operational Research group. Work in the field of vehicle maintenance by an Operational Research group of the London Transport Executive has already yielded valuable results.

It will immediately be appreciated that one of the principal novelties of Operational Research lies not in the techniques which it employs, advanced though some of these may be, but in the new sphere in which they are employed — the scientific study of the foundations of executive decision at all levels which affect the operations concerned. It can also easily be seen why Operational Research tends to arouse the almost instinctive antagonism of a large number of people.

In one organization in which the proposal to establish an Operational Research group was put forward one of the more eloquent executives expressed his dissent as follows. 'I find it hard to believe that Operational Research would be necessary if the people responsible in the first instance for solving the problems concerned did their job properly. The "scientific method" is not, surely, a technique which is known or confined only to scientists and Operational Research specialists? If it is, then this fact is indeed a disturbing comment on the training and ability of top level executives in our times. The adoption of Operational Research seems to me to be a recognition of failure; an admission that people who, in the normal course of events, should be responsible for solving the various problems which arise in their own specialized fields, lack the ability or the time or the opportunity for so doing . . . on balance the impression I gain is that Operational Research is designed to by-pass, rather than eradicate, the weakness in any given organization.'

This comment is an example of a rather oblique protest that Operational Research is, almost by definition, a *reflection* on the competence of top management. Nothing could in fact be further from the truth. The boundaries of the Operational Research group are exactly defined, not by the problems which are their province, but by the problems which *are* the province of management and of the conventional specialist. But it may equally be said of industrial

[2] I am indebted to a paper presented by Dr. T. E. Easterfield, of the Department for Scientific and Industrial Research, to the Institute of Engineers and Shipbuilders in Scotland for the details of this example.

organizations, as of Universities, that God did not see fit to divide their problems in the way that man has seen fit to divide occupations, departments and responsibilities. The best management in the world develops blind spots and the most elaborate division of responsibilities amongst various departments and specialists will not guarantee that the organization, thus constituted, will be able to define and solve every important problem that is facing it. It is the task of the Operational Research team to act as a roving eye for top management, to uncover the blind spots and to unearth the problems which may well be smouldering undetected under a morass of inter-departmental correspondence.

The management of an economic system, large or small, is in a sense a problem of cybernetics. The efficiency of management depends, firstly on the speed and quality of the information provided by the controlling mechanisms — technical, statistical, financial and economic — secondly on the degree of understanding and the quality of the judgment applied to the information 'input', thirdly on the speed and efficiency with which the executive decisions are conveyed outwards to the operating media, and finally on the accuracy with which the instructions are implemented.

There are thus four sections of the control mechanism in which serious deficiencies could arise — input, interpretation, output and implementation. It can be argued that management has the sole responsibility of discovering and remedying any deficiencies in the system but it is surely a counsel of perfection to argue that the managers themselves must personally be capable of diagnosing all and any weaknesses, of defining their precise causes and of prescribing the exact cures. It is equally absurd to suggest that, if an Operational Research group succeeds in diagnosing a weakness that was not previously known to exist, and in prescribing a cure that will raise the whole efficiency of the system, this is a reflection on the 'training and ability of top level executives in our times'. The point is that in nearly every case where an Operational Research group has functioned successfully, the weakness would *not* have been diagnosed without their assistance, since in many cases its very existence was not even suspected. The only possible reflection which could be cast on the top executives concerned would arise if, having clearly been shown the cause and cure of an unsuspected weakness in the organization, they failed to do anything about it. This is a state of affairs for which Operational Research can hardly be held responsible.

It has been proved so often, in so many different ways and circumtances, that human organizations are fallible, and that this fallibility can never be finally eliminated, that the methodical recognition of

the fact should not occasion the vociferous and indignant opposition which proposals such as the introduction of an Operational Research group seem to engender. In another organization the proposed introduction of management consultants, to carry out a reorganization and introduce new systems and methods with which the local management could not be expected to be familiar, caused much opposition until it was decided always to refer to 'production engineering' as 'work study'. It is astonishing that such face-saving devices should be necessary and even more astonishing that such a simple deception should work. But the managements in the particular industry concerned are probably not exceptional in considering that they are themselves the production experts and that the employment of 'production engineers' is therefore a reflection on their competence. 'Work study' is a more neutral, less ambitious and therefore inoffensive term. A similar penumbra of verbal dissimulation has often to be cast over Operational Research, which is in some ways merely 'work study' writ large. Instead of confining themselves to the time and motion study of individual operations the Operational Research team undertakes the broad study, by statistical and other methods, of large aggregates of operations. The mathematics of probability is substituted for the stop-watch.

If the economic system were static the need either for industrial consultants or for Operational Research would not arise. It is the dynamic element in life — the fact that systems and methods of any kind are constantly being improved, that new techniques of analysis are being discovered which highlight new and unsuspected weaknesses — that is the *raison d'être* of both. There is also little doubt that in the spheres in which the Operational Research group is designed to work the proposed division of responsibility between those who ascertain the facts and those who act on them is disturbing to executives who consider that these functions must be combined in the manager. But wherever managerial decisions normally depend on specialized knowledge no objection is taken to the temporary or permanent employment of the specialist. It is precisely because Operational Research has opened up a new field in which specialized knowledge is employed in the study of *general operations* in industry that it is regarded by many managements as an attempt to usurp their authority.

There is, of course, an element of truth in all this. An Operational Research group may investigate a problem and thereby succeed in eliminating a number of variables which are in fact discovered to be unimportant, thus narrowing the range of the problem. An executive, though he may often have been correct, may have related

his decisions to aspects of the problem which are now shown to be unimportant. If he is narrow-minded he will resent the reorientation of his mental processes which is called for by the new analysis. If he is wise he will welcome the fact that he is now able to concentrate his attention on those aspects of the problem which really do matter. The complications of status and human relations are invariably partially to blame for this state of affairs, for the elderly senior executive frequently finds it hard to give to an Operational Research group of 'bright young men' the recognition which the success and importance of their work may have earned for them.

It is the essential function of Operational Research techniques to challenge, wherever necessary, the authority of 'experience' and a large number of people in any organization have, or behave as if they have (and the distinction from this point of view is unimportant) a vested interest in experience. A successful piece of Operational Research is usually one which has isolated, defined and measured one or more of the significant limiting factors which were previously unknown, but allowed for, to a greater or lesser extent, by the experience of those responsible for giving a particular decision. The Operational Research report will usually indicate that this allowance has been too great or too small and that future decisions can now be made on a broader basis of certainty. The sphere of knowledge will have been enlarged, that of experience will have been reduced. In some areas of decision the isolation and definition of the limiting factors has for so long been considered impracticable that it has almost come to be considered undesirable. Experience has been codified and its possessors have become dogmatic and it is not only in the field of religious belief that a challenge to the dogmatic arouses fierce resistance. Innumerable instances of this reaction can be found in the history of science itself. Science, which has developed tools and modes of thought that offer an ever more powerful challenge to dogmatic thought in the scientific field, has now turned its attention elsewhere and those responsible for industrial operations will be wise not to underestimate the power of these new tools in their unaccustomed spheres.

It is precisely because of this power that the success of Operational Research in industry depends to a very considerable extent on the way in which it is used. The explosion of dogma in any sphere is liable to have a profound effect on the human relationships involved. Whether the results are in fact a threat to status and security of employment will matter little if these results are interpreted in this way by those most immediately concerned. The success of Operational Research in most of the organizations in which it has been used has

depended to a considerable degree on the skill with which the technique has been introduced and its results applied, especially in the initial stages. The subsidiary characteristics of Operational Research are closely related to this problem.

The most important of these is the relationship of the Operational Research team to the organization which it serves. There is no one pattern to which all Operational Research organizations conform, but all such organizations share certain common characteristics. The relationship of the Operational Research staff to the executives whom they serve is always as close as possible. It is essential that directives to the Operational Research group should stem from the senior executives of an organization, that the Operational Research staff should be familiar with the determinants of policy and have ready access to executive processes. This applies particularly, but not exclusively, to the senior Operational Research staff.

Operational Research projects are normally initiated both by the executives of the organization and by the Operational Research staff themselves. Many directors of Operational Research lay great stress on the right of their department to initiate projects but an equal number consider that the problem should be put up by the other departments in the organization and that the function of Operational Research is to solve either these problems or, if necessary, the underlying problems which they have been found to conceal. The essence of Operational Research is that it follows the problem wherever it may lead. There are no departmental sanctuaries or forbidden subjects. If the solution to a conventional problem requires research in a novel field the Operational Research department must have the right to pursue this research, provided this lies within the resources of the department. The solution to a problem which is tackled by Operational Research methods is often found in a field far outside that in which it was expected to be found.

Unlike the workers in normal research departments Operational Research workers are not necessarily specialists in the field to be investigated. The nature of Operational Research makes this impossible, even if it were desirable. The type of problem which has proved most amenable to Operational Research methods does not usually lie within the province of any conventional specialist. Moreover if one problem did lie within a specialist's field it is highly probable that the next would be well outside it. The disciplines of the specialist are employed wherever necessary but the specialist, if he is doing Operational Research, is as often as not required to work outside his special field. It is essential, however, that the Operational Research worker should have been thoroughly trained in the

scientific method and that he should have an instinctive distrust for the conventional, the traditional and the dogmatic. These types of thought are frequently the most profitable targets of Operational Research work. Advanced statistical methods are fairly generally used and it is desirable that at least one member of an Operational Research team should be familiar with them. It has also been found that a mixed team, containing members trained in different disciplines, is more powerful than one which consists entirely of men trained in the same field.

Operational Research must be carefully distinguished from normal experimental research. The aim of the former is to study the organization and its operations *as they proceed*. Various observational mechanisms may be installed for producing information but as a general rule there must be no interference with operations until the Operational Research has been completed. Such interference as does take place is then the responsibility of the normal executive authority and not of the Director of Operational Research, who has, and should have, no authority to initiate action on the basis of Operational Research results.

Operational Research, unlike much academic research, is intended to produce results and to lead to action. It is the object of every Operational Research team to produce a set of specific recommendations at the conclusion of any investigation. Results which are of purely academic interest but which have no relevance to policy do not interest the executive and are only of interest to the Operational Research team in so far as they are assisted thereby in obtaining the ultimate solution.

Much thought has been given to the creation of a receptive atmosphere in an organization in which Operational Research is being undertaken. A first-class piece of analysis is of no value if the operating executives and staff have no confidence in the findings for they will invariably sabotage, or at least obstruct, even the most logically convincing scheme if this is imposed upon them from outside. In the case of the National Coal Board the Operational Research groups (known as Field Investigation groups) endeavour as a matter of policy to associate local colliery officials with their investigations. The London Transport Executive, which has developed, under the direction of Mr. F. A. A. Menzler, one of the finest Operational Research organizations in England has made a practice of building up its teams, comprising 4-7 members, from the department primarily concerned with the problem under investigation. This department also furnishes the chairman. The Operational Research department supplies two members of its staff, one of whom acts as technical

secretary. These two members provide the hard core of the Operational Research team and can call on specialized techniques and methods of analysis which may not be available to the other members of the group. In this way the Operational Research department quickly comes to be regarded as the provider of a valuable service. This technique is also used by the British Iron and Steel Research Association, whose Director, Sir Charles Goodeve, a pioneer in the field, has built up a number of Operational Research groups to work on the problems of the steel industry.

The routeing of Operational Research reports should also be considered to be a matter of great importance. In London Transport great efforts are made to ensure that the relevant departments do not take up the attitude towards Operational Research reports that they are an attempt to teach them their job. Executive officials and engineers are thus associated with the work of discovery, as described above, and the first recipient of the report is the head of the department whose activities are most likely to be affected. The object in this case was to create a system whereby the department concerned would then apply the suggestions, if any, as its own. Copies of the report are also sent to the Chairman of the London Transport Executive and to the Chief Development and Research Officer. The Executive itself will only take action if all other means of persuading the department concerned to do so have failed. Similar care in the routeing of Operational Research reports is taken by the United Steel Companies of Sheffield, where the highly successful Operational Research organization is known as the Statistical Section of the Research Department. In the case of the Ministry of Civil Aviation, in which the Operational Research groups are called by their rightful name, if the project has been initiated by a 'user' department (a state of affairs which is encouraged) this department is asked to decide on the circulation of the report.

The post-war application of Operational Research techniques has been comparatively extensive, both in Government and industry. The Board of Trade, the Ministry of Transport, British Railways and Courtaulds are a few of the many organizations which have established Operational Research Departments, though in some cases their work has quite deliberately not been publicized under this name. Most of the Industrial Research organizations such as the various research establishments of the Department of Scientific and Industrial Research (e.g. the Building Research Station and the Road Research Laboratory) and many of the Industrial Research Associations (e.g. the Boot and Shoe Research Association and the Shirley Institute), as well as several of the larger industrial firms, have established Operational Research groups.

The effective use of the Operational Research *team* seems, however, to be less widespread than the sporadic use by various research organizations of Operational Research techniques. This is mainly attributable to the fact that the demand for men who are suitably qualified to do Operational Research is far greater than the supply and that even where organizations already possess such individuals they are reluctant to commit them entirely to Operational Research. But the most significant results seem to have been obtained where the Operational Research Director and his staff have no responsibilities other than the research activities of their department.

The fact that industrial organizations have been relatively slow in adopting the idea may be due partly to lack of publicity, partly to lack of personnel and partly to the opposition of vested interests. In some cases the existing research department, through failure to appreciate the distinction between Operational Research and normal industrial research, has managed to persuade management that there was nothing new in Operational Research techniques — a statement which was in all probability as true as it was irrelevant. In some firms there has been a reluctance to incur the expenditure involved in view of the apparently nebulous and uncertain nature of the possible results, and in others the proposal has been turned down on the old familiar grounds that 'it may work there but it won't work here'. Yet others have been dissuaded from accepting the idea on the grounds that Operational Research is simply another form of industrial consultancy. This idea is expressed by *Fortune*, in its own inimitable manner, as 'a lot of longhairs sporting new crew cuts!'

There is little doubt that in the techniques of Operational Research, properly employed by qualified personnel, management has been presented with one of the most powerful analytical instruments ever to be placed at its disposal. Operational Research is complementary to, and is no substitute for, industrial research in the conventional sense. It is a tool which has been developed and applied by scientists and administrators of international reputation and its use is spreading throughout government and industry. Its novelty lies, not in techniques, but in the character and importance of problems which the Operational Research group alone is competent to investigate and in the relationship of the investigator to the executive. Though the use of the technique is at present confined to large organizations with considerable resources there is every likelihood that private Operational Research organizations will be established to serve smaller firms and organizations which could not justify the employment of a full-time Operational Research team. The larger firms of industrial consultants may well decide to provide such a

service themselves. But the best results will probably continue to be achieved by full-time groups in the large organizations which can afford to hire the high-quality men who are required and to give them a blank cheque to search and discover over a wide field of diverse operations.

JOHANNESBURG, SOUTH AFRICA

THE INFLUENCE OF ECONOMIC FACTORS ON THE LOCATION OF OIL REFINERIES

(with primary reference to the world outside the U.S.A. and U.S.S.R.)

by J. D. Butler

1. *Introduction.* This article outlines the historical development of the economic influences affecting the location of oil refineries and shows how those influences bear upon a modern oil company which wishes to expand its refinery capacity. The theme of the article therefore runs from the days in which the economic advantages of refining at or near the source of crude oil production were so overwhelming that almost without exception no refinery capacity was built in market areas to the present day when a substantial fraction of the world's refinery capacity is built away from the main sources of crude oil production. An attempt has also been made to explain the circumstances in which departures from the principle of source refining have been made, and to assess the factors which may influence the location of particular refineries at the present day. Although there are important non-economic factors which influence the location of oil refineries, they have not received consideration in this article, except insofar as they are in fact brought to bear on the oil industry in an economic guise.

The expression 'oil refining' is misleading, deriving from the early years of the history of the oil industry when crude oil was required almost entirely for its kerosine yield. It was then not inappropriate to regard the process as the refining of 'raw kerosine' in order to produce a finished product. In a modern oil refinery, over 90 per cent of the crude oil is converted into useful products and the process bears little resemblance to refining in the generally accepted sense of the word. The operation of an oil refinery is to-day an industrial manufacturing process much more akin to the production from raw coal as a starting point of town gas, coke and coal tar derivatives than to, say, the refining of sugar in a pure form from the raw forms of cane and beet sugar.

The basic raw material which an oil refinery handles is crude petroleum; this varies extensively in most of its characteristics, but with rare exceptions is a true raw material of no direct value to the consumer. At the beginning of the present century oil refining was a fairly simple process; in effect the crude oil was boiled and the kerosine was distilled off. The yield from the crude oils available was likely to be under 30 per cent, even though the end product

contained significant fractions of what would presently be classified as gasoline and gasoil, the specifications for illuminating kerosine being then much more elastic than is the case today.

At the present time processing is typically continuous for twenty-four hours a day during more than three hundred and thirty days a year; the process of distillation, itself substantially changed from its earlier form, is usually the preliminary to subsequent treatments designed some to increase the yield and improve the quality of particular products, others to purify and stabilize the refined material. Rapid technical development which has taken place in the context of an immense growth in the consumption of oil products, has been the cause of significant changes in the economic factors influencing the location of oil refineries.

2. *Historical Background.* The beginnings of the oil industry are shrouded in a statistical fog. For some years petroleum was a commodity of low unit value, and carried in diverse odd types of containers ranging from wooden casks to tin cans. Early statutory records of consumption and oil movements therefore do not exist on any sort of comprehensive basis, and the long term growth of oil consumption can only be gauged from the records of crude oil production. For the period before 1920 these are the only figures which need not be treated with reserve, and they are therefore no doubt reliable indicators of the orders of magnitude involved; Table 1 below shows the growth of world production since 1900.

TABLE 1

World Crude Oil Production

Million Metric Tons

1900	20	1930	200
1905	30	1935	225
1910	45	1940	300*
1915	60	1945	365*
1920	95	1950	540*
1925	145	1952†	640*

* Including Natural Gasoline † Estimated

As a rough measure of the growth of oil consumption in this century, then, it may be said that on average over the period, consumption has doubled itself every ten years, though the rate of increase is tending to fall off. Against the background of general economic development, this growth is quite out-standing as can be demonstrated by comparing the share of oil in international trade,

which in 1950 was some 10 per cent by value against less than 1 per cent in 1900. The increase in consumption has been such as to demand a continuous extension of the sources of crude oil production, and in the course of extension the importance of various sources has undergone radical changes.

At the beginning of the twentieth century there were three important markets for oil products, the U.S.A., Western Europe and to a lesser extent the Far East; of these, the U.S. market, primarily the North Atlantic States, was by far the most important. The geography of production and market areas was even at that early date characterized by the same features that determine the latter day development of the oil industry; the source of crude oil production was away from the consuming area. This was less evident in the U.S.A. where the first oil production in Pennsylvania and the Appalachians was followed by the development of the oilfields of the Mid-Continent for the growing market area of the industrial region round Chicago, but it was for only a short time that the needs of the Eastern Seaboard could be met from contiguous sources. The development of oil fields farther afield, culminating in the massive discoveries in Texas and Mexico, took place at the same time as the expansion of the older fields. In Europe the pattern was plain from the beginning, with supplies for the western countries drawn predominantly from the U.S.A. and from the Black Sea area.

The consuming areas outside the U.S.A. drew an important part of their supplies from U.S. production from 1900 to 1938; in the years before the 1914-18 war about half of the imports of petroleum into Europe were from the U.S., with most of the remainder supplied from the countries around the Black Sea and very small quantities beginning to appear from the Far East. The rather dispersed consumption of the Far East, mainly a specialized market for kerosine, was supplied again largely from the U.S.A. although production in what were then the Netherlands East Indies was important. After the 1914-18 war, consumption throughout the world increased rapidly and the supplies available from the pre-war nexus of production could not be expanded sufficiently to meet new requirements; in particular, the Russian revolution had so reduced the level of Russian production that, except for a short period in the early nineteen-thirties, there was only a small quantity available for export. Production in the U.S.A. appeared at that time to be approaching its zenith, and as a result extensive development of other western hemisphere oil sources began; at the same time production in Persia became significant.

The decade between 1920 and 1930 was therefore characterized

by the growth in importance of production in the Western Hemisphere outside the U.S.A., first in Mexico and then in Venezuela, Trinidad and Colombia. The growth of Persian production was also of importance, and by 1930 a new supply pattern was established in which the European market drew the bulk of its supplies from the Caribbean Area (i.e. Venezuela, Colombia, Trinidad and Mexico), from the U.S.A. and from the Persian Gulf with the Caribbean and Persian Gulf becoming increasingly important. An approximate indication of the changing pattern of Europe's oil supplies can be found in the pattern of U.K. imports as shown for the period 1900-39 in Table 2 below.

TABLE 2

The Changing Pattern of U.K. Oil Supplies

Source	*1900* %	*1910* %	*1920* %	*1930* %	*1939* %
U.S.A.	61	75	61	34	23
Russia and Roumania etc.	37	16	1	17	5
Far East	2	8	5	3	2
Middle East	+	1	5	23	21
Mexico	+	+	28	6	+
Venezuela and other South America	+	+	+	17	49
	100	100	100	100	100

Source: *Petroleum Times* (Jubilee Number)

Immediately after the 1939-45 war consumption of oil products again increased with great rapidity, though, in contrast with the post-1918 period when the increasing demand for motor gasoline was the prime factor, much of the recent post-war expansion has derived its impetus from the growing industrial consumption of the medium and heavy oils. It became clear soon after the war that the Middle East crude oil producing countries were to be the source of supply for a great part of new requirements in spite of the rapid expansion of production in the U.S.A. and the Caribbean Area (cf. above), and since 1951 the Middle East has become the most important producing area outside the U.S.A. There are, moreover, signs that the Western Hemisphere may draw increasingly on Middle East supplies, and that the present flow therefrom to the U.S.A. and to South America may increase from its present relatively marginal proportions. The latest change in the world supply pattern has been the development of new fields in Canada, with indications that production could

possibly rise to a level sufficiently high to supply total domestic requirements, other than in Eastern Canada, and provide a margin for export to the U.S.A.

The continuous growth of petroleum consumption which has stimulated these changes in the world supply pattern has itself been taking place in the context of a more gradually changing market structure. Both within and without the U.S.A., there has been a gradual increase in the relative importance of petroleum consumption in the younger centres of primary production and recent industrialization. Whereas at the beginning of the twentieth century consumption outside Europe and the industrial area of the U.S.A. was relatively unimportant, the growth of mechanized road transport led to the development of important markets for gasoline in Australasia, South America and Canada. These markets, equally, were expanded by the gradual extension of the use of medium and heavy oils in industry and for ships' bunkers so that though the U.S.A. and Western Europe remain the most important markets, outside the U.S.A. and U.S.S.R. the world may now be broadly divided into six main zones of consumption:

Western Hemisphere (excl. U.S.A.):

1. Canada
2. Central Americas and Caribbean Area
3. South America

Eastern Hemisphere:

4. Western Europe, West and North Africa
5. Middle East, East Africa and South Africa
6. Far East and Oceania

3. *The Evolution of Economic Influences.* In spite of the growth of important new consuming areas, the pattern of supply and demand has remained broadly unchanged in that crude oil has its sources of production, typically, long distances from the areas in which the products derived from it will be marketed. The oil industry today continues, as in its early stages, to transport petroleum long distances from its source at the oil well to its destination in the final consuming area.

There has, however, been a significant though gradual change in the form in which the oil is moved. At the beginning of the twentieth century the movement of oil in international trade was almost entirely in the form of refined products; the crude oil was refined

close to the source of production. This remained the pattern until the end of the 1914-18 war, but thereafter new refineries began to be located in some cases in market areas; the tempo of this development was accelerated at the end of the nineteen twenties when the depression gave encouragement to policies of national autarky. At the same time the view prevailed in some countries that in the event of war petroleum supplies were better assured if they took the form of crude oil instead of refined products. The justification, if any, of this view has yet to be established.

In the recent post-war years, new refinery capacity has often been located in or near the market it is designed to serve; the rapid development of oil refining in Western Europe, for example, has changed the emphasis of oil imports into the area, from mainly refined products before the war to mainly crude oil at the present time, though there have been special non-recurring causes for this change, mentioned at the end of this section.

There have thus been two stages in the choice of location for new refineries; the first from 1900 to 1930 when new refinery capacity was typically situated at or near the source of crude oil production, the second from 1930 to the present day when the location of new capacity at or near the crude oil source has gradually become less characteristic. It is not easy to illustrate these changes statistically, principally because of the lack of early records, but an indication of changes which took place during the first stage can be obtained by comparing the roughly estimated relative importance of crude oil production and finished product out-turn on a geographical basis. Such a comparison shows that the major change in this first period was the decline in the relative importance of Eastern Europe as a producer of both crude oil and refined products. It also indicates that by 1928 refinery operations were beginning to be of some significance in Canada and Western Europe, although at the time there was almost no indigenous production in those parts, and thus that these were the first important market area refineries outside the U.S.A.

The changes which took place in the second period from 1930 to the present day are foreshadowed in the first period. It is, moreover, possible to study them more exactly by comparing the flow of crude oil and of refined products in international trade from the main producing centres to the consuming zones, as in Table 3 opposite.

The Table shows the increasing importance of crude oil imports, which rose from 16 per cent of total petroleum shipments in 1930 to over 50 per cent in 1951. The main emphasis of market refinery expansion continued to be in Western Europe and, to a lesser extent, in Canada.

TABLE 3

Oil Imports into Major Zones of Consumption
(excl. U.S.A. & Soviet Sphere)

Million Metric Tons

	1930	*1938*	*1951*
A. Crude Oil			
Canada	4.0	4.5	11.8
Central Americas	.3	.2	.4
South America	+	.3	3.4
Western Europe	2.3	11.2	55.4
Middle East	+	.5	2.5
Far East	.5	3.3	3.0
Total	7.1	20.0	76.5
B. Refined Products			
Canada	1.0	.7	4.1
Central Americas	2.6	3.8	5.3
South America	3.8	3.9	10.5
Western Europe	19.1	29.5	24.9
Middle East	3.3	6.5	15.3
Far East	8.5	9.2	15.7
Total	38.3	53.6	75.8

This gradually strenthening tendency, which has been so markedly evident since the 1939-45 war, for new refinery capacity to be built in market areas, derived its impetus from a combination of economic and technical changes together with the growth of nationalist philosophy throughout the world. The oil industry, it must be remembered, was born in an era dominated by belief in free unrestricted international trade, and the production of kerosine was an operation involving a high waste of raw material. The value of the industry's finished product was low both in volume and per unit, and thus not noteworthy to such regulating authorities as then existed. The most economic production of kerosine was evidently that involving the minimum transportation of a raw material of which a large proportion was ultimately valueless, and there were no governmental doctrines which gave *a priori* preference to the import of a raw material rather than a finished product.

After the 1914-1918 war, the economic stability of many countries was precarious and the military experience of the war had focused the eye of authority on the importance of gasoline as a strategic material. Considerations of national safety and of the desirability of restricting foreign exchange outgoings began to point, therefore, to the petroleum industry as one which might possibly be required to conduct its manufacturing operations at home rather than overseas. In one or two countries, there was a strong but illogical feeling that dependence on the goodwill of the maritime powers would be reduced if petroleum was imported in its raw rather than its finished state. The development of this policy, as has been noted earlier, was accentuated by the belief that it would save foreign exchange, a need which became acute during the depression.

These influences, however, would undoubtedly have been insufficient to change the existing pattern of refinery location had not a considerable alteration previously taken place in the character of petroleum consumption. The importance of kerosine had declined, and that of the other products increased, with a rapidity clearly indicated in Table 4 below.

TABLE 4

Estimated Relative Importance of the Consumption of Major Products

(World excl. U.S.A. and U.S.S.R.)

	*1900**	*1910**	*1920**	*1930*	*1938*	*1951*
Gasolines	3	7	25	38	32	25
Kerosines	86	72	23	9	7	7
Black Oils	11	21	46	49	57	66
Lubricants			6	4	4	2
	100%	100%	100%	100%	100%	100%

* These figures, being culled from a variety of sources, must be treated with reserve.

The Table shows that by the end of the nineteen twenties demand had evolved from its primitive 'one product' form to a pattern not radically different from that prevailing at the present time. Moreover, those changes which have taken place since 1930 have been in the direction of increased consumption of the heavier oils, with a consequent reduction in the proportion of waste or near waste material contingent on the processing of crude oil. Refinery use and

loss (including the production of unsaleable fractions) which was well over fifty per cent at the beginning of the twentieth century was of the order of ten per cent by 1930 and is today on average even lower.

The freight disadvantage of refining away from the source of crude oil had thus been substantially reduced by the late nineteen twenties when nationalistically-minded governments became seriously interested in fostering local refineries. A preferential tariff for crude oil could, and did in several countries, offset the remaining freight disadvantage and the continually increasing technical efficiency of refineries has tended to reduce the protection needed. At the same time another technical factor had ceased to militate as strongly as before against the efficiency of market area refineries. The economics of large-scale operation have always been highly significant in petroleum refining, and at the beginning of the oil industry's history were such that few markets were sufficient on their own to take the out-turn of a refinery big enough to be commercially competitive. The large increase in petroleum consumption that took place during and after the 1914-18 war meant that the size of individual markets, that is, in the large national states, had increased to a point at which certain of them could absorb the whole output of a refinery producing a full range of products at an economical processing cost. Such market area refineries, able to draw crude from a number of different sources, would be free of the limitation of their useful life imposed on source refineries by the working span of the oilfield in which they are situated.

It is clear, therefore, that at the time when political and national philosophies became interested in the location of petroleum refineries the economics of refining had changed, in such a way that the extra cost of refining away from the source of crude oil could be imposed on the consumer without blatant increases in the cost of the finished product.

Moreover, during the 1939-45 war there was virtually a standstill in refinery expansion outside the U.S.A. When hostilities ended, therefore, there was an urgent need to build new capacity which put a high premium on speedy construction. Most of the immediate post-war projects were extensions of existing plants and many of them extensions or conversions of the small speciality refineries which could be rapidly transformed into full scale refineries. The conversion of these plants, most of which were to be found in Europe, offered a quick way of raising the level of total capacity. In more normal circumstances it is quite possible that the provision of this additional capacity might have followed a different pattern.

4. The Contemporary Economic Background. In the previous section the evolution of the economic influences affecting the location of new refinery capacity was traced from that early period in which economic forces were overwhelmingly in favour of refining near the source of crude oil to the present day when the theoretical considerations against refineries located in the market area do not in all cases clearly outweigh those in their favour. The consideration of the economics of refinery location has thus ceased to be dominated by the broad division between source and market area refining and has been narrowed down to the assessment of the differing merits of possible refinery sites of which some may be in market areas, some in or close to producing areas. This is the result of the structure of the oil industry as a whole, which structure has itself been imposed by the costly and hazardous nature of crude oil production.

In considering general economic factors influencing the location of refineries today, it must be remembered that before crude oil can be produced in commercially practicable quantities, a period of exploration extending over many years is necessary. Typically this exploration takes place in remote and topographically inhospitable regions, and the cost of all phases of exploration is burdened with the expense of conducting any sort of activity in difficult and remote terrain. The necessary exploratory operations are costly in themselves, moreover, and range through a gamut of activity which is not completed until test wells have been drilled: the odds are heavily weighted against the success of an exploration well. The high cost of a multiplicity of such wells thus loads the cost of eventual success. If exploration is successful, further heavy investment must be made in gathering and transport facilities and thus even before the process of refining is begun, a heavy burden of capital charges has been incurred in making oil available. To this burden is added the cost of the refinery itself.

In this connection it is not possible to be precise about the cost of erecting a modern refinery, since not only is there a wide variation in the level of costs for apparently similar projects, but also the desirable minimum and maximum size for economic operation is always a question that must be determined separately for any particular case. As a rough yard-stick of the order of magnitude involved, however, it might be considered that since the war the minimum size for an economic full-scale refinery has tended to be about 20,000 barrels per calendar day input capacity with costs of the order of £12,000,000. A capacity of 20,000 barrels daily is not, of course, an average figure, and large-scale refineries with capacities

over 60,000 barrels daily and costing something over the £30 million mark may well be more representative of modern oil industry thinking.

The operation of producing finished petroleum products may thus be theoretically regarded as a single one, comprising a series of subdivisions beginning with exploration for crude oil, and burdened with an extraordinarily high ratio of fixed to operating costs. The heavy incidence of fixed costs imposes on the petroleum operation the need for a high and sustained degree of utilization of the various facilities in which so much capital has been invested. This financial necessity is reinforced by the technology of refining which inhibits refineries from functioning efficiently other than at or near their maximum capacity. The investment necessary for the development of additional refined product out-turn is in consequence only likely to be made if it is foreseen that the new sales outlets are fairly secure. The bulk of expansion in the oil industry has therefore been undertaken by integrated oil companies, that is, companies whose interest is not in the operation of single sub-phases of the industry's activity, such as crude production, ocean transport or refining, but with a complete interest in the production and marketing of a commodity, petroleum, which needs fairly complex processing before it can be sold.

The decision to build a new refinery is therefore typically part of a decision to expand the production side of a business in order to meet the additional sales that it is estimated can be made; and since the operation of making this additional productive capacity available will take several years the new sales estimates must be very well-grounded. There are, of course, refineries which are erected by non-integrated companies or by government sponsored bodies, but these are apt to neglect the economics of alternative locations and it is therefore desirable, in the context of this study, to confine attention to the factors influencing integrated companies. Evidently, were the influences playing on the oil industry still similar to those that have have been described as existing before the 1914-18 war, the decision would lie between the sites available at or near the companies' sources of crude oil. The cost of transporting the waste fractions in crude oil would prohibit the erection of a refinery in a market area. Today, when fiscal protection of local refining is widespread and the extra tonnage that must be shipped, if the products are moved in their crude form, may well be relatively small, the integrated company is concerned with assessing the effect on its overall operations of locating its new refinery capacity at any particular *site*. Once an economic assessment has been made of the merits of such sites as may be available, and their number is likely to be limited, then the

management of the company concerned will be able to weigh the importance of economic factors against the non-economic influences which must also determine their policy.

The expansion of an integrated company's refined product supplies to any particular area will have an influence mainly on those activities which are prior to the actual job of selling the finished product. It is, in effect a similar operation to re-designing a continuous conveyer belt manufacturing process, in which the varied activities of crude oil production, ocean transport, coastwise transport and refining correspond to different stages in the manufacture of the article on the conveyor belt. To consider a very simple case, there might be a company with an interest in a compact and isolated market that could only maintain its position in that market by expanding its refinery capacity.

The supply line might look something like this in tabular form:

TABLE 5

Hypothetical Supply Pattern

(1) Crude Oil Source at 'A' Refinery at 'A'	(1) Crude Oil Source at 'B'
(2) Ocean Transport of Refined products	(2) Crude or Products in Ocean Transport
(3) *Market Area at 'C'*	(3) *Market Area at 'C'*
50 per cent of supplies to Main Depot at 'C_1'	(*a*) Crude Oil to a new Refinery at 'C_1'
50 per cent of supplies to Main Depot at 'C_2'	Coastwise product movement to 'C_2',
	or (*b*) Refined products from 'A' to 'C_1', and from a new refinery at 'B' to 'C_2'

This is, of course, a crude schematic of what the company is doing, and the changes it could make. But, if we assume that there is no room for refinery expansion at 'A', then broadly new refinery capacity can be built at some other source of crude, 'B', or in a market area which in this theoretical case is assumed to fall conveniently into two equal parts with only two importing centres. In practice, of course, there might be other alternative sites, including some intermediately between the market and the crude oil field and there might be a host of ports serving the market area. In the hypothetical case under consideration, the company would be affected primarily by:

1. Comparative cost of crude f.o.b. from the alternative sources, 'A' and 'B', and the type of crude available at each.
2. The cost of erecting refineries at the new crude source, 'B', or in the market area, 'C', and the availability of sites in either locality close to deep water in order that ocean going tankers may have access for loading and unloading.
3. The cost of ocean transport, of crude oil or refined products.
4. The cost of coastwise product shipments from a refinery in the former place of a main depot, 'C_1', in the market area to the other main depot in the same market, 'C_2'.
5. The level of protection, if any, accorded in the market area to locally refined products.

In this simple case it has been assumed that the out-turn of a refinery at 'C_1' could be fully absorbed in the area, but in practice such a convenient disposal pattern might not occur: the extra cost of exporting products to some other area would then have to be taken into consideration. There are, of course, many other factors that would affect the operation that have not been discussed, but it is clear from this extremely elementary exposition that there can be no simple decision made on the basis of the relative costs involved. For in the supply of the total sales volume in the market area, the various economic factors affecting the supply operation are likely to affect a different percentage of the total sales according to the location selected for the refining operation; not only will the importance of each factor vary, but no two factors will necessarily vary in the same way. The assessment of the economics of refinery location is today in the first instance a question of discovering the order of magnitude of the various factors involved and secondly of giving them the appropriate weights, and it is not easy to know which is the more difficult undertaking in practice. It is evident, of course, that such non-economic considerations as strategic factors and political conditions in the producing countries are also of great importance, but they lie outside the scope of this study.

It is possible to generalize about the sort of economic factors that now influence the location of refineries. There are, still, the ancient ones of the cost of transporting waste products from the crude oil well to the refinery, and the need to have a market in the economic disposal area sufficiently large to take the output of a refinery which is making full use of the economics of scale. Then there is the difference in the cost of capital equipment, and here it is possible that the balance is moving in favour of market refineries, since the

oil company operating in remote regions may have to provide so much in the way of the facilities, including many usually thought of as public utilities, normally available in more developed areas that a very substantial burden is added to the cost of refining near the crude oil source. In much the same way, the theoretical economies of lower wage rates in under-developed areas may be offset by the high cost of 'imported' skilled supervisory staff and by the need to employ a larger unskilled labour force than would be necessary in a country where a higher basic level of industrial dexterity prevailed. The additional cost of coast-wise freight from a market refinery, which is, of course, much higher per unit than movement in ocean-going vessels, must be taken into account and it may be necessary to assess the differential cost of distribution overland from main installations as compared with movement from local refineries. The balance between the estimated production of different products from the proposed refinery and the pattern of future consumption and seasonal fluctuation must also be assessed in order to discover the likely amount of double handling and back-hauling. Last but certainly not least, the taxation regulations in the different areas under examination must be carefully studied, as they may completely upset an otherwise economically desirable proposition.

From generalization of this kind it becomes evident that because the supply of petroleum products is essentially an integrated operation, refining in the market area tends to suffer from the disadvantage of lack of flexibility to the extent that it is refining at the periphery rather than the centre of oil production. It must be remembered that petroleum demand may be subject to fairly substantial short-term fluctuations, and such estimates as an oil company may make of the future level of demand, perhaps five years or more ahead, when its new capacity will go on stream, can at best be no more than an accurate forecast of the average of several years ahead of the critical date. In all probability, therefore, the new refinery will for some period of its working existence, have a capacity in excess of the requirements of its designed disposal area. If the production surplus to requirements in the economic disposal area has to be carried back to other markets, in which the operating company lacks supplies, then the cost of transport is unnecessarily enhanced. If the market refinery happens to be situated between the source of crude oil and other main markets supplied from refineries at that source, then the flexibility of the operating company is only slightly impaired, but as has been indicated in Section 3, the main markets are typically long distances from the crude oil fields on which they depend.

It is perhaps permissible to conclude that apart from the complex of individual economic factors which today affect the location of petroleum refineries, there is an over-riding economic issue which would, in an economic world, dominate the stage, in the same way that the high cost of moving waste products defined the development of the industry from 1900 to 1920. That issue is the need for flexibility. Since the 1939-45 war the rapid increase in petroleum demand consequent on a steady improvement in general economic conditions has obscured the advantages of flexibility, and made it necessary to expand refinery capacity without pondering the disadvantages of refineries serving individual markets. Such is the present day drive of nationalistic thinking, and such appears to be the kudos attaching to the very presence of a refinery that the overall flexibility of the oil industry may well be threatened. It may not be difficult to prove that a particular market area refinery is theoretically profitable, viewed in the light of an extension of the last few years' expansion in petroleum demand and of existing fiscal protection. But should that demand fluctuate, even very much less violently than before the war, then a multiplicity of loss-incurring refineries scattered throughout the market area would not only saddle the oil industry with a most uncontrollable burden of surplus capacity, but would also in all probability be the cause of increasing selling prices to the consumer, who would have to carry the burden of ill-judged investment.

LONDON

INTEGRATION IN THE OIL INDUSTRY

by P. H. Frankel

I

The problem of integration in the oil industry has hitherto been discussed mainly from its political aspect – for its impact on the welfare of the community. Here I will endeavour to confine myself to the economic motives which lead towards integration and to those which point the other way.

The term 'integration' will be used in its accepted sense of meaning *vertical* integration within an industry – a state of affairs where some or all of its activities, from the development of the raw material to the marketing of the finished products, are carried on with a certain degree of unified control. The very word 'integration' indicates a *process* of linking units – or levels – which are or were originally independent of each other. In our case the question is whether there is in fact one oil industry or whether there are different industries – crude oil production, refining and distribution, with the transport function interposed between each two of these phases.

When the industry started some ninety years ago – almost simultaneously in the U.S.A. and in Eastern Europe – producers, refiners and marketers were certainly not identical. In the first instance all were beginners sailing, as it were, in an uncharted sea: the relationship of the various activities was not yet understood and at that stage they called for men of quite different character anyway. At the producing end a man could make a success for himself by small-scale activity sometimes in a backyard plot and luck was more important than a knowledge of geology – thus it was the adventurous type, the 'wildcatter', who was drawn towards exploring and drilling. Refining – even at its initial and primitive stage – was more of an industrial undertaking calling for the manufacturer-entrepreneur; moreover even a small-scale refinery needed more fixed and working capital than the single shallow well of those days. Finally, transport and marketing were originally not specialized jobs at all. At a time when first kerosene and later motor spirit (gasolene) was handled in tins and barrels, the ordinary dry-good transport and trade could take petroleum in its stride.

In this picture the refiner is the centrepiece in more senses than one. By the nature of things the unit of its operation was greater than that of the preceding and of the subsequent phases; this is the fact to this day: in the United States there are thousands of crude oil

producers, less than 500 refineries and a very large number of distribution companies operating through more than 150,000 retail outlets. The picture once drawn by Joseph Pogue — 'The industry assumes an hour-glass configuration, with the raw material drawn from innumerable sources, concentrated into channels of flow through the transportation and refining systems and again deploying into myriad lines of movement to countless points of final consumption'[1] — remains applicable in the United States.

Historically it is from refining that the trend came towards concentration and therefrom towards integration. John D. Rockefeller in his early days was first and foremost a refiner. There he had, in a comparatively narrow field, a chance to become bigger by being better. By being bigger he became better still, and so on almost *ad infinitum*. The crude *producer* on the other hand had but one problem: to find the oil; if he had found some his worries were over because he could always sell at a price and with his small investment he made money even if the price was low — the next man whose failure to find the oil had ended in bankruptcy did not appear in his calculation. To the *marketer* oil was but one of his lines and since some refiner or other supplied him with what he needed there was no particular incentive for him to go beyond what was his established function.

For the refiner, bent on employing his equipment, there is need for a steady outlet, if possible one which he will not lose at once to a competitor who happens to underquote his price. It is the refiner who used to go into distribution, knowing that the custom of a consumer can be counted upon with greater certitude than that of a wholesaler who is wont to switch more readily according to price and terms. Rockefeller's Standard Oil started to establish retail outlets at a time when they left crude production well alone. The direct link between production and refining belongs to a later era.

II

This historical sketch is an example of what matters: integration of several phases of an industry or, conversely, the state of their independence is a function of the unit of operation in each phase. If this unit is small and especially if it is equally small in each phase there is little incentive to branch out into the preceding or subsequent one. The great number of units on each level competing for supply on the one hand, for sales on the other, gives each operator a feeling

[1] J. E. Pogue, testifying before the Temporary National Economic Committee (TNEC) on September 25th, 1939 — *API Digest*, p. 211, *Official Record*, pp. 7435ff.

of safety; he will get what he has to buy and he will get rid of what he has to sell at a price, indeed at the *market price*, which will not be discriminatory. The position changes if on any one level the unit of operation becomes big in comparison with (*a*) the competitors on the same level (*b*) the suppliers and customers respectively on the others. In the oil industry (as in others) the units grew in size alongside a shift towards higher capital investment as compared with both labour cost and with working capital requirements. There is thus not only the need to buy more raw materials and/or to dispose of more products, but the importance of full employment of comparatively expensive plant makes *security of tenure* the permanent aim. Branching out into the subsequent (or previous) phase is more often a method of safeguarding a position than one of adventure or lust for power.

III

The single well as Unit of Operation of the *crude oil producing* industry is, of course, the extreme case. From early days onwards there were operators on some considerable scale, indeed the need to control a certain acreage of 'lease' in order to be able to space one's wells reasonably, made dwarf leases uneconomical. There was the danger that one's neighbour would drain the oil away from across the nearby borderline, which necessitated too much 'offset drilling' if the lease was small. On the whole, however, there is an almost irresistible tendency for specialized, i.e., non-integrated, operators to become and to remain active in areas — such as the U.S.A., and most European countries — where the subsoil rights are vested in the owner of the land. Where the unit of land-ownership is large there is a tendency for the attached subsoil rights to be of a similar order.

Much has changed in crude production since the early days: the cost of drilling has multiplied, and to be successful one needs an elaborate scientific service for prospecting and drilling. This, however, has been balanced recently by the greater confidence with which risk capital is prepared to move into the producing business, spurred by the irrepressible spirit of adventure — a feeling matched incidentally by the acquisitive instincts of the landowners who know how to strike a bargain with a pack of prospectors.

The picture becomes quite different for areas in which the subsoil rights are in the hands of the sovereign or the government and where they are awarded wholesale to the highest bidder, as it were, for the lot. If the unit of leasing goes up then the pattern of operation has to change apace. It is no coincidence that in the oil regions outside industrialized areas the overall concession type prevails and most

of the new oil fields discovered during the last thirty years are located in countries such as Venezuela and those of the Middle East. Whereas of the crude oil in the U.S.A. only about 60 per cent is produced by integrated companies of whom incidentally there is a considerable number, almost all the crude oil in Venezuela, Iraq, Saudi Arabia, Kuwait, Bahrain and (before nationalization) Iran was produced by seven international companies, all of them covering all phases from crude production right down to retail distribution. As a measure of magnitude, production in these six countries was in 1950 — the last full year before the nationalization in Iran — 160 million tons (3.3 million barrels per day), i.e., more than half of the U.S.A. production of the same period.

To go in for crude oil production of such absolute and comparative magnitude investment is needed on a scale which can be justified only if there is an assured outlet for the bulk of this production. For reasons which will be shown presently there is nowhere a 'market' for crude oil sustained by non-integrated refiners which could take care of output of that order; it can probably be said that without encouragement from the subsequent stages there would have been less incentive to develop oilfields in outlying areas. It is a characteristic fact that the first big effort in the Middle East — that of the Anglo-Persian Oil Company when it really became active just before the first world war — was possible only by the sponsorship of a big ultimate customer, the British Admiralty.

It appears that the business of producing crude affords a *prima facie* incentive for non-integrated activities: but that where its unit of operation is very big it is subject to tendencies held in common with all long-term and large-scale investments: finally that the structure of the initial phase of the industry is inevitably affected by that of the subsequent phases.

IV

Refining being the second stage, its problems are different; indeed it is between two fires — it has problems of supply of the raw material as well as that of the disposal of its products.

In its comparatively short history the oil industry has been subject to rapid and violent shifts in the supply position — or rather in the assessment of future availabilities. There has never been actually a shortage of petroleum — the industry has always been able to match the demand it has created — but there have been all along swings of the pendulum, and there were in turn scares of shortage and of over-production. Petroleum was inevitably a matter of 'feast or

famine'. With the incidence of shortages of his raw material always just around the corner any large-scale refiner will want to be sure of continuous supply on economic terms — he will say to himself that at times of shortage he will be better off if he has first call on a crude which is well suited for being worked in his plant and is so located as to be hauled economically to where it is wanted. It is therefore only logical that he should think of linking up with a producer on a more permanent basis than is even a long-term contract; and the producer, himself thinking of the opposite contingency of a glut of crude, may be entirely in sympathy with this idea. Both will be more inclined to do so if (for one reason or the other) there is already a certain sector on both levels linked with the other. Those who are not may in the circumstances be justified in their fear of becoming 'expendable' if things got difficult.

However, since oil has more often than not been traded in a buyers' market there is more incentive for a refiner to look for stable and preferential *sales* outlets than to provide for his own *supply* of crude oil. Thus there has always been a tendency for refiners to take an interest in distribution of their products; here again we recognize the importance of regular working to plant capacity in an industry in which the fixed capital so far outweighs the elements which are variable with turnover.

V

Before dealing with distribution as the third and final phase of the industry it is desirable to deal with the *transport* of petroleum. Large-scale transport and storage of a liquid create a set of circumstances which determine largely the pattern of trade.

What comes out of the well is either a liquid or a gas and so are — with few exceptions — all petroleum products. In the initial stage turnover was small enough to be handled in tins and barrels. Thus the solid container was moved and not the liquid itself, and conventional means of storage and transport could be used. On a larger scale the liquid had to be stored in stationary tanks and transported in big containers — ships called 'tankers' and rail and road tank cars — all of which could not be used for anything else. Alternatively the container was not moved at all but the liquid or gas was pumped along a stationary tube: for very large quantities over a set route the pipeline is most economic. The need for this specialized transport and storage equipment has tended to make these activities an integral part of the oil industry, a feature which distinguishes it from most other industries — even from those for which transport problems are of great importance, such as coal, steel or cement.

The majority of rail and road tank cars, of sea-going tankers and of river barges, and practically all pipelines, were constructed for and are run by oil companies who also mostly look after the bulk storage of their products themselves. There are exceptions — the Norwegian and Greek tanker fleets and some public storage facilities in England and on the Continent. However, the incentive for free-lance non-oil operators to enter the field on a straight service basis was and is limited by the comparative narrowness of the field, made still worse by the horizontal concentration on the several levels which reduces the number of potential customers, and thus increases unduly the risk of being left out in the cold. The main deterrent is probably the magnitude of the capital investment, which can be justified only if the storage and transport function is part of a larger picture and does not have to show a profit on its own all the time. Not without reason have even long-distance pipelines in the U.S.A. been called 'plant facilities'.[2]

VI

The Unit of Operation of petroleum *distribution* can best be described in terms of transport — so great is the importance of the transport and storage element for the final stage of the oil industry.

If we could run our cars by dissolving some tablets bought in any ordinary shop or store there would have been no need for the elaborate distribution network as we know it now. The origin of this network dates from the time when somebody first realized that there was an alternative to the traditional method of carrying the then main petroleum product — illuminating kerosene, called paraffin in England — in tins or barrels to the man who sold the stuff to the consumer. The alternative was to put a very big barrel on four wheels (a contraption soon to become known as a road tank car) and to fill *in situ* containers lent to the retailer by the supplier. This had two advantages: there were no packages to handle and the road tank cars' rounds could be run economically. Equally, if not more, significant was the fact that in return for this service and the loan of the stationary containers the retailer undertook to buy only from the individual supplier offering these facilities. In my book *Essentials of Petroleum*[3] I said: 'The liquid state of petroleum entails the tendency to develop "units" of a higher order. As soon as a certain turnover is reached the barrel system becomes outclassed by a complex organization whose unit is not, as one would be inclined to

[1] M. W. M. Splawn, *Report on Pipelines*, in two Parts, H.R., No. 2192, Washington, 1933.
[2] London, 1946, p. 37.

assume, the individual retail storage tank, but the whole machinery of bulk terminals and road tank wagons without which it could not function.'

The bigger this unit of operation and consequently the capital requirements of petroleum distribution became, the greater was the tendency to look not only for somebody who would guarantee regular supplies of constant quality but also for the assurance that the price at which the retailer got his supplies would leave a sufficient margin even if the consumer price should be depressed for one reason or the other. It is obvious that this desire for security of supply and of margin, meeting the inverse interest of the refiner to have a secure outlet, even, if necessary, at a low price, was and still is a formidable incentive for a closer link between these two levels, i.e., for integration.

VII

The consideration just referred to — the wish of the retailer to shift some of his risks further back in the chain of supply — brings out clearly one of the main problems of integration. The broader the basis on which one operates, the less danger there is that unfavourable conditions can wipe an undertaking off the map before conditions improve. Seen horizontally, this provides one of the advantages of a company operating in several areas or countries and thus able to carry on in the face of bad results in some of them. Seen vertically, the same applies: an integrated company can and will recoup itself for poor results or losses on one level of the industry by benefiting from a (comparative) prosperity on one or more of the others.

It is of course possible that at any given time all levels of the industry suffer from depressed conditions, but even then it will inevitably be a question of degree.

In the U.S.A. the crude producing industry has of late been the most prosperous part, due to some extent to the concentrated power of its political pressure groups and to its superior organization. The refining margin, large after the war, has since been compressed but is still comfortable — it is the distribution side which is the poor relation. If we can give credence to the claims of non-integrated jobbers and distributors, their integrated competitors subsidize their operations out of their more remunerative operations in production and refining.

Although there is no large-scale crude production in Europe west of the Iron Curtain, the problem is the same in Europe, because it would be possible for international companies to bear losses in their

local operations as long as they make money on foreign crude. The actual position, however, in the several European countries does not conform to any one pattern, the structure of customs tariffs and of licensing systems being too different. On the whole, since the war, refining in Europe has been remunerative, but it remains to be seen what will be the result of the investment programme now reaching saturation point.

VIII

Looking at the whole picture once more, it becomes clear that there are strong economic motives for integration of two or more levels of oil operations: in fact it is *one* industry. This does not mean, however, that there is no scope for operators who specialize in activities on one level only.

Traditionally one used to distinguish between 'Standard Oil', a term later widened to the 'Trusts' or the 'Majors', on the one hand, and the 'Independents' on the other. If the dividing line ran originally between the very big units and their smaller competitors, it has by now changed its character and the polarity is today one of integrated and non-integrated companies. The smaller integrated company will have more in common with the bigger integrated companies than with any company operating on one level only.

The non-integrated companies, though in many respects they have inherited the status and the mentality of the traditional independents, have in the course of time changed in one respect: they are now not only, or even not so much, the competitors of the 'Majors', they are their suppliers and customers. However true it may be that only integrated companies can provide the backbone of the industry, there are a number of activities on the fringes of the industry which can best be performed by specialized units, doing what the all-round operators cannot do equally well or which the latter find more practical to leave to sub-contractors, as it were.

Earlier on I referred to crude production being, under certain conditions, the natural field of action of individual enterprise: indeed the integrated companies are often very willing to buy from such producers, who in turn rely on the big companies being always takers of their crude (at a price): a large non-integrated producer in the States once described the role of the 'Majors' in this respect as that of a 'common purchaser'.

In the field of refining, the non-integrated undertaking can either go into the manufacture of specialities which lend themselves to operation on a limited scale, or conversely, in certain circumstances, a 'neutral' independent can work on a larger scale than even the

largest integrated company. This applies to cases where, for reasons of natural or political geography, none of the major crude producers and distributors of products has enough business in the respective area to build a refinery of economic size for his own requirements only. In such a case it may be possible for a non-integrated local company to serve a number of otherwise integrated companies on a 'common carrier refinery' basis.

In the case of sea transport there has been for some time the example of the Norwegian and other tanker owners who provided the 'buffer' service to all companies, thus making it possible for each integrated company to keep its own fleet down to an economic level relying on a pool of commonly available tankers to meet peak demands (which they expected, perhaps too readily, would not occur at the same time for all companies).

There is on the wholesale level some activity everywhere, which fills the 'no-man's-land' separating the big companies' spheres of activity. Finally, specialized operators — brokers and dealers — are wont to ease the flow of goods and services, from and to the big units and among them, which otherwise might tend to get sluggish at times.

At the distribution end of the industry there exists an old tradition of devolving final responsibility to men on the spot. There is obviously a limit to the number of employees for which any company will wish to be directly responsible, and for political and other reasons it is desirable to be able to point to the number of independently operating units in the distribution of petroleum products. On the other hand the security of exclusive outlets has to be maintained and what we see are various forms of a balance between the need for control and the desire to decentralize. The common pattern is formed by outlets backed financially (mainly in respect of their investment in storage and retailing equipment) and enjoying sales assistance by the supplier; in return they use (and by using strengthen) the suppliers' brand.

IX

There exists — mainly in the United States — a school of thought which starts from the premise that the oil companies, by covering all levels, have become too big and powerful and that they enjoy undue advantages over their non-integrated competitors. Thus, it is suggested, there should be, by statutory law, a 'divorcement' of their several activities and thenceforth no one should be allowed to operate on more than one level.

There is undoubtedly a great deal to be said for this argument:

integrated companies do have an edge on their non-integrated contemporaries (although we have also seen that the non-integrated operator does certain things better and also often does in fact depend on co-ordination with the overall units); the other point about power being unduly concentrated in a few people's hands by this degree of unification (horizontal *and* vertical) should also not be underrated. What is questionable, however, is whether these less desirable features can be kept within bounds only by truncating the industry altogether. We know that — left to its own devices — the oil industry has an inherent tendency towards integration and its formidable performance in peace and war is based on its structure as it has developed.

There is general agreement on the need for public opinion and for governmental agencies as its spearhead to keep a close watch on the actual performance of those who happen to wield economic power. This would include safeguards for the non-integrated units whose existence helps to avoid the oil industry becoming a 'closed shop' in the industrial sense of the word.

To go further, to interfere with the structure of the industry, is quite another thing. 'Divorcement' means excluding the effectiveness of those balancing factors which are the main incentive for integration.

It is comparatively easy for the authorities to tell an industry how to use its existing equipment but before endeavouring to do so one has to work out what result any such measure will have on further investment, i.e., on the industry of tomorrow. So far the oil industry has either re-invested its profits or has known how to attract new capital by a record of regular if not spectacular financial results. Should production, refining, transport and distribution become self-contained levels, there would undoubtedly be some additional incentive for individual investment on each level depending on the prosperity of the particular sphere of activity. It remains to be seen, however, whether such investment would assume the magnitude required without the assurance of tenure which only integration can provide. It may therefore well be that interference with the structure of the industry as we know it — a remedial step according to its advocates — may call forth the need for somebody's creative action to maintain and direct the flow of capital into spheres where it is needed. Thus an endeavour to free individual enterprise may eventually result in greater scope for management by governments. Oil is a *big* industry and any attempt to cut it up into small parcels will be self-defeating.

LONDON

INDUSTRIAL ECONOMIC PROBLEMS IN THE POST-WAR ALUMINUM MARKET IN THE UNITED STATES

by LEONARD A. DOYLE

THE aluminum market in the post-war years in the United States has provided somewhat unusual opportunities for the use of the marginal analysis by both the integrated firms producing primary metal and the secondary smelters producing secondary ingot from scrap. The opportunities for the use of marginal analysis were 'unusual' because the integrated firms pursued a stable price policy for primary aluminum in a period in which prices in general were not stable. The stable price policy for primary aluminum on occasion resulted in situations in which the prices of secondary aluminum moved upward or downward by large percentages in relatively short periods.

The purpose of this article is to explore some of the reasons for the behavior of aluminum prices in the period 1946-1951 and to discuss the implications of the market structure for the price-output decisions of both the integrated firms and the producers of secondary aluminum. The analysis was originally developed in connection with the behavior of the aluminum scrap market and the use which a vertically integrated producer might make of scrap in its own operation. The analysis had to be expanded to include the behavior of secondary producers, for they compete with the integrated firms for both raw material (scrap) and in the finished product (ingot) market. Although the major theoretical and operating problems of this analysis center around the nature of the competition between the integrated producers and the secondary smelters, a brief description of the post-war developments in the primary aluminum industry and the distinction between the primary and secondary operations constitutes necessary background for the development of a theory of behavior by each type of firm in the markets in which they compete.

1. Distinction Between Primary and Secondary Aluminum. The total supply of each of the major non-ferrous metals (aluminum, copper, lead, and zinc) consists of 'new' or 'virgin' metal processed from ore and 'used' or 'secondary' metal. Secondary metal is secured either directly from a metal fabricating plant as one of several forms of scrap, or reclaimed from an article containing the metal after the

article is withdrawn from use and scrapped. Non-ferrous scrap secured direct from a fabricating plant is termed 'new plant scrap' and that secured from articles after they are abandoned or scrapped is termed 'old scrap'. The distinction between new and old scrap is important in estimating the supply, for new scrap clearly is a function of the current rate of output of fabricating plants, whereas the supply of old scrap is a function in part of the rate of abandonment and in part of the rate of collection of metal from scrapped products.

The nature of competition between primary and secondary aluminum is influenced in large measure by the possibilities that buyers have for substituting one for the other. If secondary metal is the equivalent of primary for all uses, then one ordinarily would expect a price differential to cause users to try to satisfy their requirements with the metal selling at the lowest price. If secondary metal is not a perfect substitute for primary in *all* uses, then clearly one might expect some price differential between the two types of metal. If technical superiority or inferiority does exist, one would

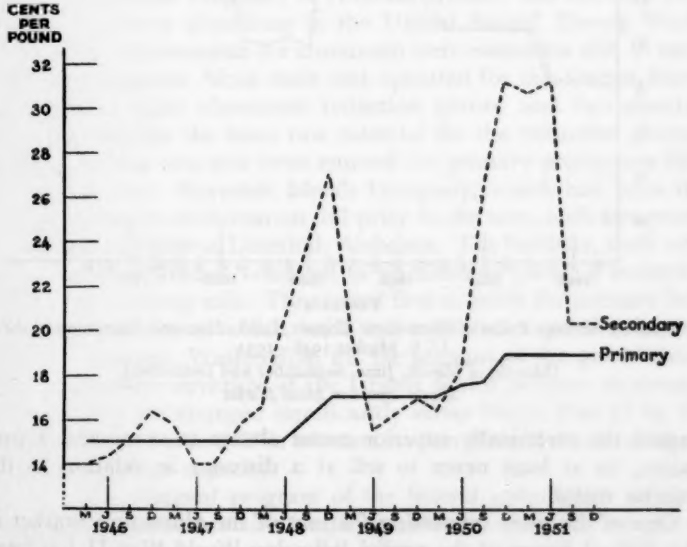

FIGURE 1

Monthly Average Prices of Primary (99% +) and Secondary Aluminum Ingot in the U. S. Market 1946–1951

(Months of March, June, September and December)

Source: American Metal Market

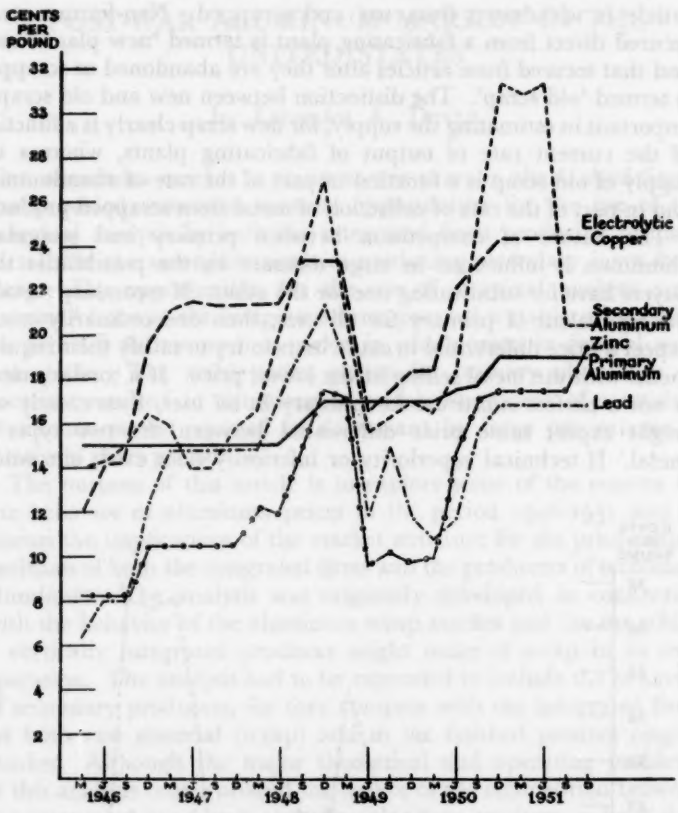

FIGURE 2

Monthly Average Prices of Electrolytic Copper, Lead, Zinc and Aluminum in the U. S. Market 1946–1951

(Months of March, June, September and December)

Source: American Metal Market

expect the technically superior metal always to command a premium, or at least never to sell at a discount in relation to the inferior metal.

One of the most interesting features of the aluminum market in the United States in the period following World War II has been that secondary aluminum prices have fluctuated within a wide range and the higher prices have been *above* the price of primary metal and the lower prices were *below* the price of primary. Figure 1 shows the prices of primary and secondary ingot of approximately

similar quality in terms of purity and other factors. The prices of primary and secondary aluminum are compared with the price movements of copper, lead, and zinc in Figure 2. As Figure 2 shows, the pattern of change of price over time for secondary aluminum is closer to those of the other non-ferrous metals than is that of primary aluminum. The relative stability of primary prices in the post-war years as contrasted with the flexibility of secondary prices clearly suggests that the market structure has been different for each. The relationships between aluminum prices and the prices of other non-ferrous metals shown by Figures 1 and 2 suggest that in the years 1946-1951 the changes in the economy of the United States which produced major movements in the price of copper, lead, and zinc operated to produce changes in the same direction for aluminum prices. The questions for the present analysis concern the failure of primary prices to fluctuate widely and the possibility that the stability of primary prices accentuated the magnitude of the changes in the prices of secondary aluminum.

2. *The Market Structure for Primary Aluminum.* Prior to World War II the Aluminum Company of America (Alcoa) was the only producer of primary aluminum in the United States. During World War II the requirements for aluminum were enormous and to meet those requirements Alcoa built and operated for the United States Government eight aluminum reduction plants, and two alumina plants to provide the basic raw material for the reduction plants.[1] During the war two new firms entered the primary production field in a small way. Reynolds Metals Company, which had been the largest producer of aluminum foil prior to the war, built integrated aluminum facilities at Listerhill, Alabama. The facilities, built with government assistance, consisted of an alumina plant, a reduction plant, and a rolling mill. The second firm to enter the primary field was Olin Industries, which built and operated a small reduction plant at Tacoma, Washington, for the account of the government. The competitive structure of the United States primary aluminum industry was not changed significantly *during* World War II by the entry of Reynolds and Olin because neither firm had a large share of total reduction capacity.

The plant disposal program of the federal government in 1946 enabled Reynolds Metals Company to become a fully-integrated producer with its own alumina plants and access to domestic bauxite. Reynolds secured enough reduction plants to give it

[1] Reduction plants are those in which alumina is converted to metallic form by electrolysis.

about 28 per cent of the economical capacity. The disposal program also brought a third primary producer into the field with about 17 per cent of the economical capacity. The third company, Permanente Metals Corporation, was one of a group of companies under the management of Henry J. Kaiser. The name was subsequently changed to Kaiser Aluminum and Chemical Corporation, and will be referred to hereafter as Kaiser. Kaiser also secured an alumina plant and a rolling mill so as to qualify as a vertically integrated producer. Kaiser did not secure domestic bauxite sources but entered into a contract with Alcoa to purchase its bauxite requirements from Surinam (Dutch Guiana). The third war-time producer, Olin, did not acquire any aluminum plants in 1946, and Kaiser purchased the Tacoma plant in 1947.

The government plant disposal program had as one of its objectives the promoting of competition in the primary aluminum industry. The plant disposal program reduced Alcoa's share of primary capacity from 100 per cent in 1940 to approximately 55 per cent in 1946. The entry of new producers, however, did not mean that effective competition was assured, for the new firms had to demonstrate their ability to survive. The new producers leased the plants from the government with options to buy. The government reduction plants regarded as 'economical' were, with one exception, those located in the Pacific Northwest and the Tennessee Valley area where electric power was available at low cost. The Hurricane Creek plant in Arkansas did not have hydroelectric power available but Reynolds was able to secure power at a reasonable price for a portion of the facilities. In order to secure low-cost power, however, the two new firms had to enter into long-term contracts which had the practical effect of making power a fixed cash cost instead of a variable cost. The power contracts called for a minimum payment based on estimated use, and if actual consumption was less than the 'firm' quantity, the minimum payment still had to be made. The power contracts had cancellation clauses, but power was and has continued to be scarce, hence to cancel would involve the risk of not being able to secure the power again if aluminum demand revived. The possibility of being unable to renew a power contract on equally attractive terms had the effect of making the power cost 'fixed' in the sense that a producer would not cancel the contract and reduce production as soon as production exceeded consumption. The two new United States producers used purchased electric power exclusively for producing primary aluminum with the government plants, and Alcoa used purchased power for a large part of its production.

The technology of aluminum production immediately after World War II was such that the cost of shutting down and starting up, combined with the cash fixed costs imposed by the power contracts, provided an incentive to each producer to accumulate an inventory of primary metal whenever market demand at the current price was less than current production. The possibility of drawing on inventory in turn tended to promote price stability when demand exceeded current production. Although the technical conditions of production tended toward stability of both output and price accompanied by changes in the inventory of metal, as we shall see there are factors which are capable of producing changes in both price and output.

The market for primary aluminum in the form of pig or ingot is not the one in which the bulk of such metal is sold to independent buyers. After the plant disposal program was completed, each of the three producers had one or more fabricating plants in which it used the bulk of its primary production. In the period prior to World War II when Alcoa was the only domestic producer of primary aluminum, its policy of allocating primary production to other fabricators presumably was part of its general long-term policy.[1] When Reynolds and Kaiser entered the aluminum industry in the post-war period, they reversed the normal sequence of production and were able to operate the fabricating plants before they started their reduction and alumina plants. Such a procedure was made possible by the existence of stockpiles of primary aluminum, alumina and bauxite, and was a sensible procedure in terms of a profit-seeking enterprise. The demand for aluminum sheet in the first few months after Reynolds and Kaiser acquired the government plants was so great that each firm was able to utilize in its own fabricating plants all the primary metal it could produce in addition to aluminum secured from the government stockpile, and so neither firm had an immediate incentive to enter the primary pig and ingot market.

The bulk of the plant disposal program of the government was carried out in the first part of 1946 and the two new producers were shipping sheet products from the leased rolling mills in the second half of 1946. By the time the government plants were started a considerable backlog of demand for fabricated aluminum products had developed and the new producers had little difficulty in selling

[1] Students of the monopoly problem in the United States generally have argued that Alcoa deliberately restricted the sale of primary metal to independent fabricators. The company, however, has contended that its dominant position in the fabricating field resulted from inability or unwillingness of independent fabricators to develop new markets for aluminum, and as a consequence it had to perform this function itself.

all the sheet products they could turn out during the last half of 1946 and the first quarter of 1947. The fact that the rolling mills started production before the government reduction plants were activated depleted the government stockpile of aluminum pig.

The negotiations surrounding the government plant disposal program probably exerted some influence on Alcoa to keep its prices at the war-time level after price controls were removed in 1946. The decision to maintain prices almost certainly contributed substantially to the high level of demand for aluminum in the last half of 1946. The stable price policy of Alcoa in 1946 resulted in an aluminum shortage in the sense that purchases from the fabricating plants exceeded the current rate of output by the reduction plants. For a time the shortage was met by drawing on inventories of pig and scrap accumulated during the war, but by the end of 1946 such inventories were very low and independent fabricating companies found it difficult to secure all the ingot they wanted at the published prices. During 1946 and the first quarter of 1947 neither of the new producers appears to have offered any significant quantity of primary pig or ingot to independent fabricators.

3. *The Market Structure for Secondary Aluminum.* The production of secondary aluminum in the United States is carried on by a relatively large number of independent smelters. Since large quantities of electric power are not required for secondary aluminum, the producing units tend to locate in or near large industrial areas to secure both markets and a scrap supply with minimum transportation costs. Secondary smelters buy aluminum scrap and alloy material from scrap dealers or direct from fabricating plants and so look to the margin between secondary ingot prices and scrap prices to cover conversion costs and provide a profit. Aluminum scrap is a raw material which may be used by both the independent smelter and by the three integrated producers in their own fabricating plants. (The integrated producers can combine scrap aluminum with primary metal in the 'remelt' furnaces in which the particular alloys required for rolling, extruding, forging or wiredrawing are produced.) Secondary aluminum is consumed chiefly by foundries, and by steel plants. The steel plants use aluminum shot as a deoxidizing agent, hence this use removes aluminum from the available supply.

In the development of the secondary aluminum industry, the smelters have concentrated on the production of ingot for foundries which in turn produce aluminum castings, and the production of shot as a deoxidizer for steel mills, with heavy emphasis on the

former. The emphasis on foundry ingot was due to two factors, technical suitability and the size of the market. Foundries rely chiefly on secondary ingot, but some foundries require a large percentage of primary because of the technical specifications of their products. A foundry which can use secondary, however, is technically able to use primary ingot, and the choice will, in such cases, be made on the basis of price. Foundries which require primary can substitute secondary only if the latter meets the same specification for purity and metallurgical properties. The foundry market is the most 'competitive' of the various groups consuming aluminum, 'competitive' being used in the sense that purchases are made on the basis of *price* in relation to a given technical specification. Although foundries buy on a price basis, they are not immune to such considerations as assured supply, prompt delivery, and uniform quality.

The demand for secondary ingot by foundries is derived from the demand for aluminum castings which are used in a variety of assembled products, including automobiles, appliances, cooking utensils, outboard motors, aircraft engines, architectural ornaments, etc. In general, it is reasonable to argue that price is not the sole determinant either in the decision to expand the number of uses for aluminum castings or in the fluctuations of demand for present uses of aluminum castings, i.e., in the total quantity of castings required. New uses for castings are developed by research, and the total quantity of castings required at any one time is related to the general level of economic activity. Thus one can see that price may not determine whether or not the order for castings will be placed, but it will determine which particular foundry will get the order. By the same reasoning, price may not determine the quantity of secondary ingot to be bought by the foundry, but rather which particular secondary producer will get the foundry's order.

In general, the supply of secondary ingot is less than the total requirements of foundries, therefore one may argue that the total requirements of foundries are, in the present state of the industry, close to the maximum market which smelters can secure, provided they can get scrap. The fact that ingot made from primary metal can be substituted for secondary ingot means that the primary producers can encroach on the secondary market if it is to their advantage to do so.

The markets for primary aluminum in the form of pig and ingot and for secondary aluminum are similar but not identical. The most significant fact about the two markets is that under one set of conditions the primary producers compete with the secondary

producers in the raw material (scrap) market and not in the finished product (ingot) market, and under another set of circumstances the primary producers may withdraw, in large measure, from the raw material market and compete chiefly in the finished product market. The integrated producers are concerned first with selling primary metal; consequently they will use scrap primarily to expand total output when demand is high and cut back or eliminate scrap when the market does not require the available supply of primary metal. An understanding of the nature, sequence, and limits to competitive behavior between primary and secondary producers is of great importance to firms in each industry in planning their operations.

If the primary aluminum industry did not consist of vertically integrated firms, one might argue that primary and secondary ingot producers would compete directly for sales to aluminum fabricating plants, and that the fabricating plants would compete with secondary smelters for aluminum scrap whenever scrap could be used instead of primary metal. The existence of vertical integration in the primary aluminum industry combined with the policy of stabilizing price and production at the expense of inventory fluctuations is the setting in which one must study the market relationships between primary and secondary aluminum.

It was pointed out above that Kaiser and Reynolds actually did not immediately enter the primary aluminum ingot market after they got the reduction plants in operation but instead used all their output in their own fabricating plants. The fluctuating ratio of primary and secondary production combined with the alternate discount and premium prices of secondary aluminum is explained by the 'surplus-shortage' policy of pricing practiced by the primary producers. As was pointed out earlier, the present (and prospective) price structure of primary aluminum is relatively insensitive to short-run fluctuations in demand, and the rate of output of primary aluminum is similarly insensitive to short-run fluctuations in demand. If the demand for primary aluminum at the prevailing price is not enough to absorb current production, the difference between the quantity produced and the quantity used will be accumulated in inventory by the integrated firms (primary producers). The factors which will eventually operate to curtail primary production may be either the exhausting of financial resources of the primary producers, a decline in scrap prices to a level below the equivalent variable cost of primary, or a combination of the two.

A period in which primary production *exceeds* consumption will be a 'metal surplus' period and will tend to *reduce* both scrap prices and secondary ingot prices. When the level of effective demand at the

established prices requires *more* primary than the current rate of production provides, a 'potential shortage' situation exists. The shortage will become *actual* after the deficit lasts long enough to use up any inventory of primary accumulated in the preceding period or periods of surplus. If a stable price for primary continues to prevail after the inventory is depleted, the excess of effective demand over current output will result in a premium of secondary prices over primary, and in intense competition by primary and secondary producers for the available aluminum scrap.

4. Factors which Influence the Production of Secondary Metal by the Integrated Firms. The integrated firms, Alcoa, Reynolds, and Kaiser, 'produce' secondary aluminum in two ways: (1) in that they use *purchased scrap* in their own fabricating operations, and (2) in so far as they actually operate a secondary smelter establishment. In 1947 only Alcoa produced secondary ingot for sale, but all three firms used varying quantities of purchased scrap in combination with primary metal to produce metal for certain of their own fabricated products. The economic desirability of using purchased scrap in a fabricating plant depends on the relation of the *price of scrap* to the *cost of primary aluminum*. If primary aluminum is 'short', the use of scrap *increases* the output of fabricated products and the profitability of such a procedure depends on the relation of the marginal net revenue of the added production to the price of scrap.

The integrated aluminum producers are likely, as a matter of policy, to transfer material from one plant to another on the basis of the going market price. In the case of a rolling mill, the market price procedure provides autonomy for the mill in deciding how much scrap it can use to advantage in relation to the market price of pig. If scrap is below pig in price, the mill will use as much scrap as technical conditions permit. This procedure forces the reduction plants to dispose of the displaced pig. In a metal shortage, the mill may be expected to buy additional scrap as long as the cost does not exceed marginal net revenue.

A stable price for primary aluminum maintained long enough to create a 'shortage' in a period of high demand will force the fabricating plants of the integrated firm to attempt to secure aluminum scrap in competition with the secondary smelters. In this sort of competition, however, the smelters probably will not suffer in the sense of securing a smaller total quantity of scrap. The high rate of demand means a higher rate of operation of all or most fabricating plants, hence a larger supply of new plant scrap. The increase in demand which produces the 'shortage' is likely to be the result

of a general increase in business, hence the foundries will require more metal. The existence of a 'shortage' of primary aluminum means that in this period the integrated producers are rationing primary pig and ingot to the independent fabricators, therefore these will turn to the secondary smelters and so bid up the price of secondary ingot. The smelters, consequently, can afford to bid up the price of scrap and compete effectively with the integrated producers.

5. The Marginal Analysis as a Factor in Determining Operating Policy. The foregoing description of the nature of the primary and secondary aluminum markets provides an explanation of the alternating premium and discount relationship between secondary and primary aluminum shown by Figure 1. The analysis of the market, however, must go beyond demonstrating the possibility of price movements and deal with the factors which tend to *limit* the premium-discount relationship. The limits tend to be set by the marginal rate of substitution by the integrated firms of aluminum scrap for primary metal. The stability of primary prices in relation to the flexibility of secondary prices provides unusual opportunities for the use of the marginal analysis by firms in both the primary and secondary industry. The formation of policy on the basis of marginal comparisons provides an explanation of the forces which tend to limit the premium and discount for secondary in relation to primary. The following description of the use of marginal comparisons seems to the writer to represent substantially what both integrated and secondary producers do.

If a metal shortage develops, what factors may be expected to set an upper limit to scrap prices, and so to the secondary ingot prices? The integrated producers should bid for scrap as long as its cost is less than its marginal net revenue. The stable price for ingot is a part of a similar policy for the price of the fabricated aluminum products for which the great bulk of primary aluminum is utilized by the integrated producers. If the price structure for fabricated products provides revenue in excess of fabricating cost including metal at the market price, then the individual fabricating plant will be able to utilize scrap as long as its price, on an equivalent cost basis, does not go above the market price of primary by more than the margin realized on primary at the market cost basis. When scrap reaches this price the plant will find that further purchases at high prices will result in a situation in which marginal cost will exceed marginal revenue. When scrap prices become so high in relation to the market price of primary that the fabricating plant

managers can no longer use scrap profitably they will stop bidding up the price and leave the field to the secondary smelters. If the integrated firms persist in a stable price policy for primary, there is no reason why the prices of scrap and secondary ingot cannot continue to rise even after the primary producers withdraw from the scrap market.

If scrap prices can, in theory, go high enough to force the integrated firms to withdraw from the market, what should one expect of the integrated producers in a period of declining demand? The relationship between primary and secondary production varies from year to year and seems to be based primarily on the nature of competition in the primary market. The ratio of secondary production to primary tends to fall in prosperity and increase in depression, therefore we must inquire as to the effect of this on the relationship between the *price of scrap* and the *price of primary aluminum*. The movement of the ratio of secondary production to primary production is *inversely related* to the ratio of scrap prices to the price of primary, with the scrap price ratios going up as the ratio of secondary production to primary production declines, and going down as the ratio of secondary production increases. The turning point in the price ratio, however, lags behind the turning point in production by one or two years.

Downward pressure on scrap prices is the result of two forces: (1) the decreased demand for castings, hence a decreased demand for secondary ingot, and ultimately a reduced demand for scrap, and (2) the fact that the supply of old or obsolete scrap is likely to be constant because it is not necessarily a function of the current rate of business activity.[3] It is true that the supply of new plant scrap should be closely geared to the demand for castings, but the backlog which results from the peak production of fabricated products immediately preceding the downturn in activity may result in an excess of scrap supply in relation to demand (in quantitative terms) based on the assumption that new scrap supply and castings requirements are relatively insensitive to price.

When the demand for fabricated aluminum products falls below the balance point the primary producers will have excess production of primary metal. If the excess is large and continues for a substantial period the integrated firms will attempt one or more of the following alternatives, in the order listed:

[3] There is some evidence that the volume of old scrap collected and made available through dealers is influenced by the amount of unemployment. Scrap collecting may be a marginal occupation which falls off in periods of high employment and increases in periods of low employment. Such cyclical behaviour would account for the relatively constant supply (as compared with new plant scrap) and would offset the presumed higher ratio of abandonment in periods of good business.

(1) The fabricating plants will be instructed to withdraw from the scrap market even if, on a market price basis, scrap can be used to advantage.

(2) Attempts will be made to expand the sale of metal by reducing prices, increases in promotion activity, or both.

(3) The production of primary metal will be curtailed.

In order to see the logic of the order of steps suggested, it is necessary to consider the effect of the alternative steps in a different sequence. Let us start with the attempt to increase sales, particularly of pig and ingot, on the assumption that the primary producers will be reluctant to disturb the price structure of fabricated products until they have first explored other possibilities. If primary producers attempt to increase sales of pig and primary ingot, they must compete with each other and the secondary smelters. As a group they can increase their business only at the expense of the smelters. This can be done in several ways: aggressive selling without cutting prices, price reductions, or a combination of the two. Whichever method is employed will, if successful, reduce the sales volume of the secondary smelters and (since the integrated producers are out of the scrap market in order to utilize their pig capacity) force down the price of scrap. Since the smelters operate on a manufacturing margin, they can cut the prices of secondary ingot as scrap goes down and hold their share of the foundry market, or even increase it.

It seems unlikely that the integrated producers would find it to their advantage to encroach on the market of secondary smelters unless the quantity of metal they sell in this market is large. In order to make it profitable to capture a part of the secondary market, the integrated companies would want to be certain that price reductions there would not be followed by price reductions on the fabricated products which comprise the bulk of finished product sales, i.e., sheet, rolled products, extrusions, etc. It would, conceivably, be possible for the integrated firms to maintain prices of their major wrought products and put pressure on the price of castings. As a matter of self-interest, however, the integrated producers would have to consider the elasticity of demand for the whole aluminum market and not for castings alone in making price changes in the secondary aluminum market.

Next, let us consider the first alternative, the withdrawal of integrated fabricating plants from the scrap market. The three primary producers use the major part of their primary production in their own fabricating plants. In addition to primary aluminum, these fabricating plants *can* use a varying percentage of purchased

scrap. The three majors will use scrap in preference to their own primary pig if the price for scrap is favorable in relation to the cost of pig. The value of pig to each major is dependent upon the alternative uses, i.e., (1) sale to other fabricators or (2) use in its own plant. To illustrate the comparison, let us suppose that at the existing prices for castings and wrought aluminum products, there is excess pig producing capacity, i.e., the market demand declines enough to change a 'shortage' to a period of inventory accumulation. How should this affect the relative prices of pig and scrap and the utilization of each?

In order for the integrated firms to increase their own use of pig without reducing the prices of wrought products and castings, the out-of-pocket cost of producing pig must be less than the market price of scrap on an equivalent yield basis. The foregoing may be illustrated by assuming that at the start of a period of 'surplus' aluminum scrap costs 15 cents per pound, and has a 10 per cent melt loss, and that pig costs 14 cents, excluding from cost all fixed charges. With such price-cost relationships, the integrated producers would stop buying scrap and use only virgin metal. When the integrated firms stop buying scrap, the secondary smelters become the only purchasers, and the first effect of a withdrawal of the integrated firms from the scrap market would be to produce a reduction in the price of scrap.

Is it possible for the secondary smelters to absorb the entire amount of scrap offered? The answer to this depends on the outlets for secondary ingot. At the present time, secondary ingot is used primarily by foundries, with some production going to roofing sheet, some for destructive use as a deoxidizing agent, and some to the chemical industry. Probably all of these uses are capable of expansion through price reduction. Since the secondary aluminum industry is composed of a large number of firms, a greater degree of competition will exist, and it is to be expected that price reductions will be made in order to secure the increased volume possible with the increased supply of scrap. It seems to follow from this that it is impossible for the prices of primary and secondary ingot to be identical unless the integrated firms in effect regulate the supply of scrap to secondary smelters — and to do this, they must either stockpile scrap or reduce the production of pig, or both.

Let us consider the sequence of events if an integrated producer were to continue to produce more pig than it requires for its fabricating plant, and violates the marginal principle by allowing the fabricating plants to buy scrap on the basis of its market price in relation to pig at a 20 cent market price and a variable cost of 14

cents per pound. To reduce the inventory of primary aluminum, the company must push pig sales (or primary ingot) to such non-integrated buyers as foundries, extrusion plants and rolling mills. Presumably primary ingot has some advantages which secondary does not have, assuming the same price per pound. As the corporation becomes more aggressive in selling primary metal, it will make inroads on the secondary smelters and force them either to contract production, cut prices, or both. As the secondary smelters lose business to an integrated firm, they will buy less scrap and presumably the price of scrap will go down. As the price of scrap goes down, the mills of the integrated firms will buy more scrap, thereby using less pig and forcing the sales department to dispose of more metal (pig and ingot) to non-integrated fabricators. The substitution of primary ingot for secondary at foundries and other non-integrated fabricating plants will therefore be accompanied by a substitution of scrap for pig at the fabricating plants of the three integrated firms as well as a decline in the price of scrap and a reduction in the volume of secondary ingot sold.

What will be the reaction of the secondary smelters to the foregoing? As long as primary and secondary ingot are the same price, primary, when available, will be substituted for secondary. The secondary smelters will have to accept the reduction in volume unless they have a manufacturing margin per pound great enough to warrant a price cut. One result of the substitution, conceivably, is to drive the smelters out of business. Unless they can offer more attractive prices and/or service than the producers of primary ingot, they might be forced out of business.

In order for the integrated firms to capture the total ingot market and, in effect, eliminate the secondary smelters, they must take over the function of the smelters as buyers of scrap. To apply a 'price squeeze' the integrated firms would have to buy enough scrap to keep scrap prices so high in relation to ingot prices as to make it impossible for smelters to cover their cash costs. Such a policy presents the following alternatives:

(1) If the price squeeze is accomplished by reducing the price of primary ingot, it will be difficult to avoid similar reduction in the prices of fabricated products. Since the primary firms sell the bulk of their metal in fabricated form, the loss in revenue on fabricated products will almost certainly exceed the gain in revenue from pig and ingot.

(2) If the price squeeze is accomplished by bidding up the price of scrap, the cash cost of inventory accumulation of primary

metal must be considered. If the primary firms apply a price squeeze, they must either process the scrap at a loss or hold it in inventory and sell primary. If the scrap cost exceeds the marginal cost of primary pig and ingot, the alternative of accumulating an inventory of scrap will be worse than that of accumulating an inventory of primary metal.

The foregoing alternatives seem to provide no net advantage to the integrated firms. Apart from public policy considerations with respect to anti-trust laws, therefore, one may conclude that the integrated firms would not find it profitable to preempt the whole market. The critical profit comparison rests on the relationship between the marginal cost of producing primary metal and the cash outlay required for an equivalent quantity of scrap.

Let us consider, therefore, what an integrated firm should do if a 'metal surplus' starts to develop and its fabricating plants are buying scrap at prices above the marginal cost of primary metal. The integrated firms will stop treating the fabricating plants as independent concerns and take an integrated view, i.e., consider the profit on pig. Since pig sales to outsiders have contracted, should the companies restrict the production of pig? Certainly not, if primary pig costs less than scrap. Suppose, for example, that it does cost less than scrap. The integrated producers would stop buying scrap at their fabricating plants and substitute pig, and will do so until the equivalent price of scrap falls below the out-of-pocket cost of pig. As the integrated producers curtail the purchase of scrap, the secondary smelters become the only buyers. To sell to them, the scrap dealers and independent fabricators must cut prices — and for the smelters to increase secondary ingot sales volume, they in turn must cut prices. Further reductions in the price of secondary ingot will force further contraction of primary ingot sales by the integrated producers. The limit of substitution of secondary for primary ingot appears to be when the three majors consume no scrap — and for this to be economical, the price of equivalent scrap must equal or exceed the out-of-pocket cost of pig.

The third alternative, the curtailing of primary production, is in part one which may be approached by the marginal analysis and in part by considering the financial resources of the integrated producers. An integrated firm should not use scrap when its price is above the marginal cost of primary unless it can sell all the primary it *wishes to sell*. An integrated firm, of course, may believe that a particular period of metal surplus is to be of short duration and so may use as much scrap as possible in order to *maximize its inventory*

accumulation of primary metal. In a period of metal surplus the integrated firms by definition are able to supply more primary metal than the market requires *at existing prices.* The sales of metal may produce a cash margin of receipts over variable cost, but any accumulation of inventory will constitute a drain on cash. There will be some level of demand for each integrated firm below which cash generated by current sales will be less than cash required by financial commitments (interest, dividends, sinking fund deposits, debt retirement, etc.) and inventory accumulation. When inventory accumulation proceeds to the point at which it threatens to impair the financial resources of the firm, one should expect production to be curtailed.

The policy of the integrated firms of curtailing scrap purchases when the marginal cost of primary is below equivalent scrap prices will minimize the cash drain of inventory accumulation. The curtailment of scrap buying by the integrated firms, however, will tend to depress scrap prices. The decline in general business which produces the metal surplus will also affect the foundry market, and the foundries will shop around for bargains in secondary ingot. The smelters will try to widen the margin per pound between ingot and scrap to compensate for lower volume, and the withdrawal of the integrated firms from the scrap market presumably will assist the smelters in accomplishing their objective.

The withdrawal of the integrated firms from the scrap market will tend to depress scrap prices. The next question is: Can scrap prices fall enough to make it advantageous for the integrated firms to curtail primary production and buy scrap? If one rules out the role of expectations which lead to speculative inventory building by primary producers and considers only the cash cost alternatives, integrated firms should stop producing primary metal and use scrap instead to the full extent possible when the price of scrap on an equivalent yield basis falls below the marginal cost of primary metal. Even if an integrated firm is speculating in inventory to the maximum extent permitted by the current market situation in relation to its resources, one may conclude that it should enter the scrap market when scrap prices fall below the marginal cost of primary. Such a policy will maximize the inventory accumulation possible with given financial resources.

6. *Conclusions.* In terms of the foregoing analysis, one may conclude that an integrated firm should stop buying scrap in a period of metal shortage when the price of scrap becomes so high that the marginal cost of the resulting fabricated products exceeds the

revenue derived therefrom. If this price is substantially the same for all integrated firms, one should expect 'internal pressure' for a general price increase from the plant managers of the integrated firms. Each plant manager may accept the price for the products of his plant as long as sales do not exceed possible production (i.e., he may not concern himself as to whether or not the price structure really maximizes profit), but once he finds that sales exceed possible production he will bring pressure for a price advance. A general price advance for primary will eliminate some of the advantages of the secondary producers and so operate to reduce the differential between primary and secondary. A price advance which eliminates the 'shortage' will, by definition, eliminate the premium of secondary over primary.

If the primary aluminum industry passes from a shortage to a metal surplus, the application of the short-run (i.e., cash position) marginal analysis will cause the integrated firms to reduce or discontinue scrap buying as long as scrap prices are above the marginal cost of primary metal. If the integrated firms do not have to follow the policy of conserving cash they may elect to buy scrap as a part of a program of speculating in inventory for a future increase in demand. Such a program will, as a by-product, tend to keep both scrap and secondary ingot prices at a higher level. If the primary producers try to preserve a stable price policy, one may argue that this will force them to maintain secondary prices at some 'reasonable' relationship to primary prices in order to prevent one set of fabricated product prices (castings) from getting out of line with the prices of the other fabricated products produced largely by the integrated firms.

The nature of the competition between the vertically integrated primary producers and the independent secondary smelters appears to be such that the secondary smelters can compete effectively in both the scrap market and the ingot market. The primary producers do not appear to have inherent advantages sufficiently strong to enable them to take over the functions of the secondary smelters; certainly there do not appear to be profit prospects sufficient to tempt the primary firms to take the whole secondary market. Although the integrated primary producers may not have a strong incentive to capture the entire secondary market, there may well be some advantage to an integrated firm in having one or more secondary smelting operations. A complete analysis of the advantages, primarily in terms of market strategy, of a secondary operation is beyond the scope of this article. It may be suggested, however, that the major advantage to the integrated firm is the possibility of

using the secondary market as an outlet for primary metal in a period of metal surplus. If a primary producer finds that it is not maintaining its 'position' in the primary market and so is forced to accumulate inventory at a faster rate (in relation to production) than its competitors, the ability to sell primary in the form of secondary will give it 'leverage'. The 'leverage' may deter its competitors from attempting to increase their market shares. Some support of the foregoing argument is provided by the fact that each of the new integrated producers in the United States established one or more secondary aluminum plants prior to the outbreak of the Korean War.

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THE PROBLEM OF INTRODUCING MODERN SYSTEMS OF WAGE PAYMENT INTO THE BOOT AND SHOE INDUSTRY

by J. CRAWFORD

I

THIS Paper is based on the experience I have had in seeking to introduce work study, or operational research, into the Boot and Shoe Industry. It may have a wider significance but in writing this Paper I am fully conscious of a pull in opposite directions.

The record of the Shoe Industry in the field of industrial negotiation and arbitration has been so outstanding that the first impulse is summarily to reject any new idea which appears to threaten it, and yet one is all the time conscious that either well tried principles of labour relations must go or they must conform to modern trends or techniques by a change of emphasis.

In 1895 there was a dispute in the shoe industry and the outcome was a document called the 'Terms of Settlement'.[1] Many of its details are not important today or relevant to our discussion, but that document laid down, in broad and general terms, a procedure and machinery which is acted upon and which is the main reason why no national stoppage has occurred in the past 56 years. Under these terms a Trust Fund was created, contributed to equally by Union and Manufacturers' Federation, and in the event of a strike or lockout, either side can claim against the Fund. If a dispute should occur, or a lockout, three days' grace is allowed to either side before an action for compensation can be commenced. This penal clause only accords with justice, because quite adequate machinery was created under the Terms of Settlement which rendered it unnecessary, in that Arbitration Boards were created for every district in which the craft was practised.

The Terms of Settlement govern the constitution of these Arbitration Boards, to which all disputed matters are referred which cannot be settled in the factory or by the local trade union officials.

More generally, the industry operates under a National Agreement between the Union and the Federation, negotiated every two years, and which fixes basic rates and conditions of work, and disputed matters very often have to do with an interpretation of that

[1] This settlement has become of historical importance in the development of Trade Unionism. Readers might like a reference to a recent article, 'The Origins of Industrial Peace: the Case of the British Boot and Shoe Industry' by Elizabeth Brunner, *Oxford Economic Papers*, June 1949.

Agreement. The principal task of the Boards of Arbitration and of their sub-committees, however, and one which is most relevant to the subject of this paper, is that of compiling piecework basic statements for their particular districts, which are inviolate as basic prices for every operation of shoemaking. Readers may ask, why not one national statement? The answer is that Boards work within the provisions of the National Agreement as well as the Terms of Settlement and are empowered to fix piecework prices for every operation, having due regard to operations where exceptional skill or length of training is required, so as to give an average earning capacity of 25 per cent over the basic rate. Exceptional skill is covered by a 37½ per cent plussage instead of 25 per cent.

Each Board, therefore, has to achieve this average earning capacity within its district. The corresponding piecework price will be affected by quality standards. Therefore, as quality work tends to be consistent in districts to a district average standard, but not to a national one, basic statements vary from Norwich and Leicester, and even between Leicester county and the city of Leicester. Similarly, the town of Northampton pays much higher prices for each operation than do the neighbouring districts of Northamptonshire. The test applied by a Board is not the piecework price but the earnings.

Anyone familiar with the technique of industrial consultants must be thinking 'this is the very setting for their methods', and it would be but for one thing, namely, that in each district the statement is basic, although plussed by additions to the basic rates here and there in each factory and from factory to factory, in order to compensate for operations yielding insufficient earnings at those rates. The work-measurement technique of industrial consultants, on the other hand, is essentially based on the individual factory.

Although the power to fix district piecework statements was implicit in the Terms of Settlement of 1895, the Industry conformed to it at first only to the extent that the prices which were fixed for most operations were employed as measures of daywork performance, and it was not until 1919 that piecework was accepted as the basic method of wage payment. In 1919, therefore, each district built up piecework statements through the aegis of the local Arbitration Board. They are neither Union nor manufacturers' documents, but Board documents, having in the industry the force of law. From that point, a worker, or a manufacturer, a local trade union branch official, a manager or a foreman, had only to report a violation for action to be taken.

It is important to note that not only does this machinery exist but it is known to exist by even the most ordinary worker. It is

brought down to the factory level by our 'Procedure in cases of dispute' which outlines the sequential steps to be taken, as for instance: 'The worker must first report the matter in dispute to the foreman', and from that initial stage the entire process begins to work. If, for example, a member of ours arrives at a local office of the Union with a grievance, be it price of job, conditions, etc., the question is always posed: 'Have you reported the matter to the foreman?' and, if the answer is 'No', that instruction is given. We find that many so-called grievances just happen along and the charge-hand is unaware of them and, in any instance where this procedure is not followed and the charge-hand becomes aware of it only when one of my officers calls to deal with it, there is usually a feeling of resentment.

This Conciliation machinery has been tried and tested and the proof lies in a freedom from national disputes for over 56 years. It is obvious from the foregoing that, when a question of a price for an operation does reach the Union official, failing satisfaction at the factory, the Secretary of the Arbitration Board when called in must rule on a past decision of the Board for or against employer or trade union. The evidence upon which a ruling is given is in the District Statement or in the files or the Addenda produced from time to time.

This method of ours has flaws — especially when compared with more scientific price-fixing methods. Fixed as they were many years ago in terms of existing experience (however much they have since been modified) and applied to the operation as a watertight value for a quantity of work, all prices have departed from their original foundation on past experience, as management has improved, as work has simplified, as transport of work has been bettered, with such varying results that in numerous instances the lesser-skilled jobs are rewarded with the highest average earnings. On the other hand, as every price is a sort of fresh-water pool in the middle of the Atlantic Ocean, having no relation to its environment, if organization were bad or work-flow intermittent, average wages would be lower and in the same area the same price would produce very different earnings.

I submit, however, that despite the inadequacies of our present system, the essential framework of our Conciliation and Arbitration machinery must remain. It is the keystone of the arch and the industry would be wise to examine how it can be made to fit into the future.

Summing up the foregoing, the Arbitration Boards and subsidiary committees, based on the Terms of Settlement of 1895, have done a first-class job for the shoe industry. The machinery of conciliation

is well understood by management and worker and it is through this understanding that for over 56 years peace has been preserved. The industry is anxious that it shall continue to function with undiminished authority and it fears the introduction of more modern techniques which, it is felt, will destroy all that has been built up over half a century. This fear is shared by manufacturers and officers of my Union and the workers generally are on the defensive.

II

What is the biggest difference of principle between the piecework statement system described here and a system of work measurement embodying the incentive principle? Piecework Statements measure wages earned for a given output and in the shoe industry prices are calculated in dozens or gross of pairs. Both the price and the earnings are recognizable at a district statement level. They are understood.

The science of work measurement and control has many factors, culminating in Standard Minute Values. These can only be accepted by workers as 'standard' because the piecework price has been surrounded and protected by other factors which guarantee standard conditions which, if departed from, relieve the worker of his contract to accept them. It means, in fact, an examination and rectification of input and throughput, flow and transport of work, reserves of work in progress and an arrangement that, if time is lost through any failure of these conditions, the employer shall accept the responsibility of paying for the time lost.

Indeed, it is only following such arrangements that the stopwatch is brought into use and the assessment factors for speed and effective work calculated. This work can only be done separately for each factory, as alteration of layout, positioning of machines, etc. will each have relation to available space — all this is outside the scope of a district Arbitration Board.

It is to be expected too, that machinery efficiency will vary from factory to factory, and a district statement cannot provide for this contingency as the plus and minus element involved cannot be measured precisely at a distance. The varying efficiency of factories is covered only casually today; on the one hand, by paying extra where workers would otherwise not get the basic earnings, and on the other, by the additional earnings accruing to workers where outputs are higher than envisaged in the basic statement. When wages are based on work measurement in the factory, the machinery efficiency should be part of the work specification and set-up; the

revolutions per minute and other data at the time of fixing values should be recorded as part of the standard conditions referred to above.

Job evaluation is important too. The National Agreement distinguishes only piecework which should earn 25 per cent over basic rates, and the more highly skilled operations, which carry a 37½ per cent plussage, as mentioned on p. 232. The practice of industrial consultants must vary with every industry, but they frequently operate with eight job evaluation ranges, averaging from an expectation of incentive bonus of 25 per cent to one of 45 per cent over base rate. For my industry that is too many, but *two ranges only* give little scope and, where we have consultants or their technique, we have agreed upon three — A.B.C. — and one juvenile grade.

The two grades operating now as a standard for incentive payment apply to specified operations of modern shoemaking and the operations were classified by Arbitration Boards. Considered on a district basis, it has worked well, but even within a district, quality requirements vary and, where they do, they affect the principle of job evaluation, which again throws us back to the factory level.

Perhaps the greatest advantage the shoe industry can obtain from the abrogation of district statements and the adoption of Standard Minute Values factory by factory is the opportunity to measure the effective work done on products of a different basic structure or for a different customer range. Many factories have a mixed production of men's and women's footwear, welted or machine sewn, welded and veldtschoen, and it is of little value to say a firm produces 5000 pairs of welted and 6000 pairs of machine sewn. It means little as a comparison of effective work. If, however, the industry was functioning on the basis of Standard Minute Values, a comparison of Standard Minutes produced on each category would be an effective comparison.

Despite the fears and inhibitions referred to earlier, quite substantial progress has been made in the introduction of wages based upon the system of work measurement, mainly because as President of the Union, I believe this to be the way of progress for us — for manufacturers, higher output per man-hour with consequent lower unit costs, and, for workers, an even higher earning capacity. This view is not yet fully endorsed by my National Executive, nor have I as yet felt it wise to submit the principle to a full Congress, but I am able to proceed by reporting progress from time to time.

Fortunately, progress has been possible in areas remote from the main shoe manufacturing centres — for example, in Somerset, Westmorland, and in Scotland, with beneficial results to management

and workers. This has been possible because in Somerset and Westmorland no district statement was upset, being areas where one firm only is operating, producing merely a local reaction and, indeed, where normal arbitration machinery based on a consensus of opinion of many firms is not possible.

In one of the traditional centres of shoe manufacture, two experiments were commenced and stopped at an interim stage through the fears of my local members, and, whilst working to principles which one day may cover the entire industry, those principles are not yet the accepted policy of my Union through the mandate of our Biennial Conference.

In another traditional centre, work measurement, whilst improving earning capacity, reduced specific prices, when translated for comparative purposes from Standard Minutes, to pence per dozen or gross. This resulted in an employer member demanding the right to reduce those same prices in his factory below the district basic piecework price, although his operations had not been subject to work study.

The shoe industry is one in which the main future development towards greater efficiency lies exclusively in the field of work measurement. When comparisons are made with American productivity, there can be no alibi for it of low capital investment, power use per operative of electrical energy, or inferiority of machine tools. Its make-up is basically similar to American shoemaking, its machinery comes from the same source, and its labour force is much more craft conscious than the average American worker.

Tradition dies hard, but experience is hastening its demise. The first venture we entered upon over three years ago produced almost at once a 35 per cent increase of shoes, 25 per cent increase of earnings, and 51 per cent increase measured in Standard Minutes. The most recent report of our latest venture is of an unprecedented increase of productivity of over 90 per cent secured in the first fortnight of a new layout and new values. In this latter case it was evident that loose pricing and tight pricing were both militating against efficiency. The operatives on loose prices, though assessed at a 75 or 80 performance, at the end of the week had produced only the equivalent of a 40 performance. In this instance of an over 90 per cent increase in output, the aggregate wage for the team involved increased by 35 per cent, certainly not in the same ratio as before.

The above experiences are typical of the industry, varying from factory to factory, but the importance really lies in the fact that no capital expenditure is involved in getting these improvements, other than minor jigs or other small devices.

111

There is one other most important factor that should be mentioned. That is, the relation of productivity, as an end in itself, and the economic use of scarce and expensive raw materials. It is part of the craft training of a top cutter (upper leather cutter), and a stuff cutter (bottom leather, soles etc.) to apply skill to produce both quickly and to a costing. This is present practice and would be difficult to amend without much conversion of thought. Nevertheless, in all factories where these two departments are the subject of work measurement principles, we are agreeing principles of payment in our skilled grades on a 133 productivity performance, and *in addition* an incentive bonus on material saving, which is extremely remunerative to employers and workers. Our experience is that, *a priori*, skilled men in these departments just do not believe that they can cut more closely than they do, yet in every case so far, considerable saving of material has resulted. To obtain favourable results the incentive on material saving must be reasonably generous.

The most recent instance of workers' refusal to believe there was room for improvement was one in which, after being addressed at a long session, they unanimously refused to give the scheme a trial. I have always, up to this particular time, laid it down emphatically that my own agreement was dependent on the agreement of the members concerned, but, on this occasion, I gave the firm the signal to go ahead. I was able to reconcile this action through securing a 100 per cent guarantee of existing piecework rates for a period of 4½ months, with a signed statement from the Managing Director that the workers would determine by vote at the end of the trial period whether to continue on the old or the new way of working. Thus we had two measurements proceeding together. The result was never in doubt as the combination of the two, production and saving, produced substantially increased earnings. Workers sometimes just do not know what they can do until they try something out.

The importance of this latter experiment lies in the emphasis as between production and saving. One of the principal objectives of productivity is reduced costs. Here is our experience. The Standard Minute Values can undoubtedly produce for the average worker a 133 performance. We are satisfied of that. The material saving bonus can produce 50s. incentive payment by a saving of an additional 5 per cent of leather. The workers very quickly place the emphasis where, in their view, they want it, with the result that instead of an average production performance of 133 or thereabouts, it is averaging 125 showing greater emphasis on material saving.

IV

It appears obvious to me that, for a considerable time, two different methods must be permitted. The district statement must continue to apply in the usual way for all factories not surveyed by operational research, the local Arbitration Boards functioning as they have up to now as the arbiters on price questions. We should now examine how the conciliation machinery, *retaining all its authority and discipline*, can be modified to fit the new circumstances.

Whatever is done, we do not feel we can allow the chaotic circumstances to arise with the application of method study and operational research as pertains in the American shoe industry, where every factory, though basically similar in work measurement, has an entirely different method, or transfer value, of relating the measured value to wages. It appears obvious to me that we must reach an understanding with the Manufacturers' Federation on basic principles. We should determine in a national way the degree of job evaluation that should be permitted, i.e. how many grades of progressive skill shall be permitted for adult workers, both sides using their knowledge of the craft aspect of the industry in arriving at a sensible decision.

Agreement should also be reached on the principle that Standard Minute Values should be as scientific as is possible so that there is one yardstick of effective work and performance running through all the grades of skill. Agreement should be reached for each grade of skill as to the target wage for an incentive performance of 133 (or an 80 performance in other terminology.) It would be better too, because of our long experience of piecework, that a straightforward piecework system should be developed in each factory rather than have a mixture of bonus incentive or other variant.

Leather being expensive, quite fractional periods of time spent in closer cutting may produce more economic results than an average 133 performance with the pre-incentive wastage. The accountant in one firm using this two-way system has stated that, with raw material costs as high as they are now, a 1 per cent saving of material is equal to a 20 per cent increase of productivity in the costing of a shoe.

The two incentives, productivity and saving, whilst they are independent, are interrelated in such a way that the highest reward is attained by a good performance in both fields of endeavour. In actual fact, in the instance referred to here, output in pairs of uppers produced is on the average the same as prior to the introduction of work measurement, but the aggregate wage of the cutters has risen by 15 per cent, and the firm have been able to reduce their cutting costs quite substantially.

It should be obvious from the foregoing that District Statements cannot cater for work measurement practice. The basis of the modern techniques must stem from the factory to the Arbitration Board, not the other way round.

Standard Minute Values are not only a substitute for straight piece work of pence per quantity, they have value in costing and planning being measurements of time as well. Yet, I have on my desk a memorandum of some manufacturing friends of mine who solicit my views on introducing work measurement in their factories, and using our present method of price per dozen to translate into wage factors. At the time of the initial introduction of such a hybrid system no doubt it would be effective, but with the passing of time those factories would be as they are now, without an additional tool of planning.

The most essential feature of whatever agreement ultimately emerges is that the basic principles should be uniform throughout the entire industry, as otherwise the industry will never speak the same language: we should never be able to discuss principles at a Conference without interpretation being necessary and we should never be able to educate not only our many Branch Officers and Executive members but— perhaps what is more important ultimately— also our rank and file, who should be as fully versed in the new methods as they have become in the old piecework methods.

The basic departure from our present method is that, whereas (1) today the Arbitration Boards have the duty of providing piecework prices which will enable an agreed plussage over basic rates to be earned, averaged out over all the factories in the district and naturally producing booms and slumps in earning capacity between one factory and another on that district statement, thereby necessitating factory adjustments in an upward direction where organization does not give the required earning capacity, (2) under the new method the Arbitration Board will be the guardians of a principle which, instead of going from the Board to the factory, works backwards from the factory to the Arbitration Board. In other words, it would be the duty of the Board, if appealed to, to determine that a specified performance in each grade of skill is being rewarded with the plussage agreed upon within the new National Agreement for each grade of skill.

It should mean that, when we speak in future of an average earning capacity of adult males or adult women, we are not dealing with an average produced as the happy mean of high wages and low wages, but of an average wage which, in fact, represents far more scientifically what workers are actually earning in the industry. It

is well understood by management and worker and it is through this understanding that for over 56 years peace has been preserved. The industry is anxious that it shall continue to function with undiminished authority and it fears the introduction of more modern techniques which, it is felt, will destroy all that has been built up over half a century. This fear is shared by manufacturers and officers of my Union and the workers generally are on the defensive.

II

What is the biggest difference of principle between the piecework statement system described here and a system of work measurement embodying the incentive principle? Piecework Statements measure wages earned for a given output and in the shoe industry prices are calculated in dozens or gross of pairs. Both the price and the earnings are recognizable at a district statement level. They are understood.

The science of work measurement and control has many factors, culminating in Standard Minute Values. These can only be accepted by workers as 'standard' because the piecework price has been surrounded and protected by other factors which guarantee standard conditions which, if departed from, relieve the worker of his contract to accept them. It means, in fact, an examination and rectification of input and throughput, flow and transport of work, reserves of work in progress and an arrangement that, if time is lost through any failure of these conditions, the employer shall accept the responsibility of paying for the time lost.

Indeed, it is only following such arrangements that the stopwatch is brought into use and the assessment factors for speed and effective work calculated. This work can only be done separately for each factory, as alteration of layout, positioning of machines, etc. will each have relation to available space — all this is outside the scope of a district Arbitration Board.

It is to be expected too, that machinery efficiency will vary from factory to factory, and a district statement cannot provide for this contingency as the plus and minus element involved cannot be measured precisely at a distance. The varying efficiency of factories is covered only casually today; on the one hand, by paying extra where workers would otherwise not get the basic earnings, and on the other, by the additional earnings accruing to workers where outputs are higher than envisaged in the basic statement. When wages are based on work measurement in the factory, the machinery efficiency should be part of the work specification and set-up; the

revolutions per minute and other data at the time of fixing values should be recorded as part of the standard conditions referred to above.

Job evaluation is important too. The National Agreement distinguishes only piecework which should earn 25 per cent over basic rates, and the more highly skilled operations, which carry a 37½ per cent plussage, as mentioned on p. 232. The practice of industrial consultants must vary with every industry, but they frequently operate with eight job evaluation ranges, averaging from an expectation of incentive bonus of 25 per cent to one of 45 per cent over base rate. For my industry that is too many, but *two ranges only* give little scope and, where we have consultants or their technique, we have agreed upon three — A.B.C. — and one juvenile grade.

The two grades operating now as a standard for incentive payment apply to specified operations of modern shoemaking and the operations were classified by Arbitration Boards. Considered on a district basis, it has worked well, but even within a district, quality requirements vary and, where they do, they affect the principle of job evaluation, which again throws us back to the factory level.

Perhaps the greatest advantage the shoe industry can obtain from the abrogation of district statements and the adoption of Standard Minute Values factory by factory is the opportunity to measure the effective work done on products of a different basic structure or for a different customer range. Many factories have a mixed production of men's and women's footwear, welted or machine sewn, welded and veldtschoen, and it is of little value to say a firm produces 5000 pairs of welted and 6000 pairs of machine sewn. It means little as a comparison of effective work. If, however, the industry was functioning on the basis of Standard Minute Values, a comparison of Standard Minutes produced on each category would be an effective comparison.

Despite the fears and inhibitions referred to earlier, quite substantial progress has been made in the introduction of wages based upon the system of work measurement, mainly because as President of the Union, I believe this to be the way of progress for us — for manufacturers, higher output per man-hour with consequent lower unit costs, and, for workers, an even higher earning capacity. This view is not yet fully endorsed by my National Executive, nor have I as yet felt it wise to submit the principle to a full Congress, but I am able to proceed by reporting progress from time to time.

Fortunately, progress has been possible in areas remote from the main shoe manufacturing centres — for example, in Somerset, Westmorland, and in Scotland, with beneficial results to management

and workers. This has been possible because in Somerset and Westmorland no district statement was upset, being areas where one firm only is operating, producing merely a local reaction and, indeed, where normal arbitration machinery based on a consensus of opinion of many firms is not possible.

In one of the traditional centres of shoe manufacture, two experiments were commenced and stopped at an interim stage through the fears of my local members, and, whilst working to principles which one day may cover the entire industry, those principles are not yet the accepted policy of my Union through the mandate of our Biennial Conference.

In another traditional centre, work measurement, whilst improving earning capacity, reduced specific prices, when translated for comparative purposes from Standard Minutes, to pence per dozen or gross. This resulted in an employer member demanding the right to reduce those same prices in his factory below the district basic piecework price, although his operations had not been subject to work study.

The shoe industry is one in which the main future development towards greater efficiency lies exclusively in the field of work measurement. When comparisons are made with American productivity, there can be no alibi for it of low capital investment, power use per operative of electrical energy, or inferiority of machine tools. Its make-up is basically similar to American shoemaking, its machinery comes from the same source, and its labour force is much more craft conscious than the average American worker.

Tradition dies hard, but experience is hastening its demise. The first venture we entered upon over three years ago produced almost at once a 35 per cent increase of shoes, 25 per cent increase of earnings, and 51 per cent increase measured in Standard Minutes. The most recent report of our latest venture is of an unprecedented increase of productivity of over 90 per cent secured in the first fortnight of a new layout and new values. In this latter case it was evident that loose pricing and tight pricing were both militating against efficiency. The operatives on loose prices, though assessed at a 75 or 80 performance, at the end of the week had produced only the equivalent of a 40 performance. In this instance of an over 90 per cent increase in output, the aggregate wage for the team involved increased by 35 per cent, certainly not in the same ratio as before.

The above experiences are typical of the industry, varying from factory to factory, but the importance really lies in the fact that no capital expenditure is involved in getting these improvements, other than minor jigs or other small devices.

III

There is one other most important factor that should be mentioned. That is, the relation of productivity, as an end in itself, and the economic use of scarce and expensive raw materials. It is part of the craft training of a top cutter (upper leather cutter), and a stuff cutter (bottom leather, soles etc.) to apply skill to produce both quickly and to a costing. This is present practice and would be difficult to amend without much conversion of thought. Nevertheless, in all factories where these two departments are the subject of work measurement principles, we are agreeing principles of payment in our skilled grades on a 133 productivity performance, and *in addition* an incentive bonus on material saving, which is extremely remunerative to employers and workers. Our experience is that, *a priori*, skilled men in these departments just do not believe that they can cut more closely than they do, yet in every case so far, considerable saving of material has resulted. To obtain favourable results the incentive on material saving must be reasonably generous.

The most recent instance of workers' refusal to believe there was room for improvement was one in which, after being addressed at a long session, they unanimously refused to give the scheme a trial. I have always, up to this particular time, laid it down emphatically that my own agreement was dependent on the agreement of the members concerned, but, on this occasion, I gave the firm the signal to go ahead. I was able to reconcile this action through securing a 100 per cent guarantee of existing piecework rates for a period of 4½ months, with a signed statement from the Managing Director that the workers would determine by vote at the end of the trial period whether to continue on the old or the new way of working. Thus we had two measurements proceeding together. The result was never in doubt as the combination of the two, production and saving, produced substantially increased earnings. Workers sometimes just do not know what they can do until they try something out.

The importance of this latter experiment lies in the emphasis as between production and saving. One of the principal objectives of productivity is reduced costs. Here is our experience. The Standard Minute Values can undoubtedly produce for the average worker a 133 performance. We are satisfied of that. The material saving bonus can produce 50s. incentive payment by a saving of an additional 5 per cent of leather. The workers very quickly place the emphasis where, in their view, they want it, with the result that instead of an average production performance of 133 or thereabouts, it is averaging 125 showing greater emphasis on material saving.

IV

It appears obvious to me that, for a considerable time, two different methods must be permitted. The district statement must continue to apply in the usual way for all factories not surveyed by operational research, the local Arbitration Boards functioning as they have up to now as the arbiters on price questions. We should now examine how the conciliation machinery, *retaining all its authority and discipline*, can be modified to fit the new circumstances.

Whatever is done, we do not feel we can allow the chaotic circumstances to arise with the application of method study and operational research as pertains in the American shoe industry, where every factory, though basically similar in work measurement, has an entirely different method, or transfer value, of relating the measured value to wages. It appears obvious to me that we must reach an understanding with the Manufacturers' Federation on basic principles. We should determine in a national way the degree of job evaluation that should be permitted, i.e. how many grades of progressive skill shall be permitted for adult workers, both sides using their knowledge of the craft aspect of the industry in arriving at a sensible decision.

Agreement should also be reached on the principle that Standard Minute Values should be as scientific as is possible so that there is one yardstick of effective work and performance running through all the grades of skill. Agreement should be reached for each grade of skill as to the target wage for an incentive performance of 133 (or an 80 performance in other terminology.) It would be better too, because of our long experience of piecework, that a straightforward piecework system should be developed in each factory rather than have a mixture of bonus incentive or other variant.

Leather being expensive, quite fractional periods of time spent in closer cutting may produce more economic results than an average 133 performance with the pre-incentive wastage. The accountant in one firm using this two-way system has stated that, with raw material costs as high as they are now, a 1 per cent saving of material is equal to a 20 per cent increase of productivity in the costing of a shoe.

The two incentives, productivity and saving, whilst they are independent, are interrelated in such a way that the highest reward is attained by a good performance in both fields of endeavour. In actual fact, in the instance referred to here, output in pairs of uppers produced is on the average the same as prior to the introduction of work measurement, but the aggregate wage of the cutters has risen by 15 per cent, and the firm have been able to reduce their cutting costs quite substantially.

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It should mean that, when we speak in future of an average earning capacity of adult males or adult women, we are not dealing with an average produced as the happy mean of high wages and low wages, but of an average wage which, in fact, represents far more scientifically what workers are actually earning in the industry. It

will give to manufacturers the opportunity of measuring effective performance within the varied construction ranges of different types of shoes. It will enable them to measure more effectively the labour units required at each stage of manufacture and should help them in the costing of the product in a far more efficient way than they are able to do at present.

To the workers, it ought to give a higher earning capacity; it ought to mean that the inhibitions and frustrations of the present due to breakdowns and bottlenecks are eliminated, and the comparison of departmental performance in the Standard Minutes paid for as against the Standard Minutes earned should be a guarantee both to worker and to management that lost-time is eliminated: where it is not, the method is a guarantee to the worker that it will be paid for and will be the responsibility of the manufacturer.

It may perhaps mean that to remove doubts and fears on both sides, each Arbitration Board will employ full-time an expert on operational research and method study, if only to act as an impartial umpire in the future development of these principles.

Whatever the future holds one thing stands out crystal clear, and that is that there is no room in a closely integrated industry like shoemaking for a variegated approach to this question. One principle, one common language is necessary, so that the long history of good labour relations may continue.

EARLS BARTON, NORTHAMPTON

THE CONTROL AND OVERSIGHT OF CAPITAL EXPENDITURE WITHIN UNILEVER*

by L. G. Norton and J. E. Wall

I. INTRODUCTION

In any concern the purpose of capital expenditure is to ensure that fixed assets will be available which, together with the necessary working capital, will effectively carry out the agreed commercial plans of the concern. This expenditure will range over a very wide field, from minor replacements on the one hand, to the construction of major new plants on the other. Potential capital expenditure will normally exceed the available financial resources — again after taking account of the additional working capital required. The primary objective of any system of control of capital expenditure accordingly must be the selection of those capital projects which bring the greatest benefit to the concern.

In this note an attempt is made to relate this apparently simple proposition to the actual method of controlling capital expenditure within the Unilever Concern. The first section sets out some of the general problems affecting the control of capital expenditure; the second section gives a brief outline of the organization of Unilever, thus providing a necessary preface to the third section, which sets out in some detail the procedure which is followed within Unilever for the oversight and control of capital expenditure.

II. GENERAL CONSIDERATIONS AFFECTING THE CONTROL OF CAPITAL EXPENDITURE

A special feature of capital expenditure is that it frequently involves locking up money for a fairly long period of time and in specific fixed assets which may be of little or no value elsewhere. In addition, in these days of exchange control restrictions in many countries, it may also involve locking up resources in a particular country with uncertain prospects about the remittance of profits and eventual repayment of capital.

Two general points arise from the outset. Capital expenditure is essentially a continuing flow of expenditure through time. In any dynamic concern, this flow will be continuing in good and in bad times. Naturally the rate of flow will vary, reflecting on the one hand, for example, changes in commercial prospects and plans, movements in the general level of costs, and the incidence of large

* Since this article was written we have seen a copy of a publication by the National Industrial Conference Board Inc. entitled *Controlling Capital Expenditures* — Studies in Business Policy No. 62. This publication gives an exhaustive study of the methods used by a large number of American companies to control their capital expenditure.

projects, and on the other hand, changes in the supply and cost of financial resources available for investment in fixed assets. However, for various reasons it is both necessary and convenient to divide this flow of expenditure into given periods of time; e.g. there are statutory obligations upon companies to provide annual accounts. There is, moreover, the need for any firm to consider at definite intervals of time the longer term financial implications of the rate of flow of its capital expenditure. At the same time, it is necessary to recognize that to review the flow of capital expenditure for any given period of time in the future introduces some artificial factors into the picture. A year may be at once too long and too short a period of time.

The second general point concerns the practical difficulty of estimating in advance, within a reasonable margin of error, the amount of capital expenditure. Some items can usually be estimated fairly precisely, especially when they are small and will be paid for quickly. Others raise real problems, especially when the construction of the plant or equipment is spread over a fairly long period of time. Construction costs may change; the availability of materials may vary, especially where there is the physical control by governments; the delay in providing any particular piece of equipment may hold up the entire project indefinitely; where investment takes place overseas, rates of exchange may differ during the course of construction, and, lastly, technical problems may be met during the course of construction which could not be foreseen. Moreover, technical development does not stand still — better ways of doing a job are always being found and, even within the short space of a year, some items in any capital expenditure budget may drop out and new ones be brought in.

The general aims of any system of controlling capital expenditure must be five-fold:

(*a*) to decide on which new fixed assets expenditure will be incurred after allowing for the unavoidable expenditure which has to take place (e.g. essential replacements). Since potential capital expenditure will usually exceed financial resources, this stage is essentially one of determining priorities — of selecting those projects which will best achieve the commercial plans of the company. The broad system must therefore be such as to facilitate the comparison of the return upon differing projects;

(*b*) to provide that the fullest use is made of the expert knowledge within the concern so that the decisions of selection can be made on the basis of the best expert knowledge available;

(*c*) to ensure, in particular, that those projects selected will be of the highest technical standard within the financial limitations set upon them;

(*d*) to provide for proper financial oversight of the capital expenditure undertaken. In times of rapidly changing costs, care must be taken to ensure that the final cost of the fixed asset still bears the appropriate relationship to the value of the flow of services expected from it;

(*e*) to ensure that the system will operate flexibly and speedily. Provision must be made for reasonable changes in the project without too much reference back. Moreover, although it may be possible in some cases to take time about considering capital expenditure, in others the time factor may be important.

Taking each of these five aims in turn, the first concerns the selection of those items to which the available financial resources should be devoted. In theory, those items should be selected which will yield the highest return on the money to be invested, although this is less apparent in the case of replacement items. For other items, in practice two difficulties arise at once. First, account must be taken of 'external' factors which hinder the selection of projects solely on their expected rate of return. Second, the actual measurement of the rate of return on new capital expenditure — and for that matter of existing capital employed — is far from easy and at times is virtually impossible.

The 'external' factors may be taken first. A good deal of capital expenditure is 'unavoidable' in the sense that it is influenced largely by factors outside, or at best only partly within, the direct control of any concern. Obvious examples are the safety regulations under the Factory Acts, the host of other regulations by Central and Local Government, the general working conditions expected by organized labour, social amenities for the staff, and the like. These are, perhaps, the lesser difficulties. More important are:

(*a*) The activities of competitors. It may often be necessary to undertake capital expenditure to meet pressure from competing firms. The new expenditure in itself may not be relatively profitable but unless it is made the whole competitive status of the company can be impaired. The return on such expenditure must clearly be related not to the actual new fixed assets produced but to the effect on the profitability

of the entire enterprise if the expenditure were not made. This is notably true of the improvements in the quality of the products sold. Firms will normally be seeking to give consumers an improved product — indeed, they must do so if sales are not to decline and the value of the existing assets thus be impaired. But the financial cost of this action may often be high.

(*b*) The importance of maintaining earning power — i.e. the need to preserve the return upon, and thus the value of, existing assets. In any well-established business, it is from the existing assets that the bulk of profits must come. Much of the new expenditure must therefore be directed towards preserving the earning power of these existing assets. Frequently, therefore, new capital expenditure may have to be incurred which yields a small return in itself but does, in fact, preserve a substantial investment which would otherwise become less profitable and in some cases might even be lost. In general, in any large concern brand new projects standing on their own feet are few and far between. Much more frequent is the need to make expenditure on replacing or improving existing assets, when the new expenditure becomes inextricably mixed with the old and the return upon it can be considered only in relation to the expected yield on the total investment involved.

(*c*) The policies of governments. Government policy at times enforces investments which are not economic, especially where that policy reflects nationalism in the economic as well as the political sphere. For example, a government may refuse to licence the import of certain products in order to force some concern to set up plant for making the products in the country itself. The return on the investment in the new factory itself may be meagre and may indeed be less than the return on the goods previously imported. There may also well be better uses for the money thus locked up. Nevertheless the investment may have to be made in order to ensure that the company's products are not excluded from the market in that country.

(*d*) The pace of technical development. In some fields the pace is so great that existing assets become obsolescent and must be replaced long before their proper life is run. Provided that the competitive position permits it may be possible in

such cases to ensure that the rate of return on the new fixed assets covers the loss on the shortened life of the assets replaced. But this is not always possible.

(*e*) Errors in commercial planning. Capital expenditure is incurred in relation to commercial plans which are themselves only assessments of the likelihood of a certain volume of manufacture or of sale. If these assessments are wrong the capital expenditure itself may prove to be mis-applied. This is obviously the case when sales fall short of expectation, e.g. owing to changes in the public's preference for certain products. The new fixed assets are thus insufficiently used. But it can be equally true when sales exceed expectations. In a competitive market the failure to have your product available whenever a consumer demands it may well mean a decline in the total volume of sales. In order to make sure that the consumer can always buy the product whenever he asks for it a further expansion of investment may be required. Fortunately it may be possible to spread such overheads as advertising and marketing costs over a larger sales volume and thus reduce costs, but the construction of the additional plant which was not foreseen when the original project was planned may prove to be less economic than the original plans.

When we turn to the actual measurement of the return on new capital investment, other difficulties of a different nature are encountered. In theory, the proper use of capital resources involves the measurement of the expected return on the new fixed assets together with any additional working capital and its comparison with the cost of the new money thus locked up (compared with current borrowing rates — if it is possible to borrow — or with its probable return if used elsewhere). Only in this way can we be sure that the marginal net productivity on capital does not fall below the prevailing long term borrowing rate and that comparisons can be made among competing projects for investment. In practice such measurement is usually inexact and at times impossible, and at all events the required return on new investments will always be substantially in excess of the current long term borrowing rate. The substantial amounts of replacements do not permit of measurement. Nor do many additions to existing plant. In some cases, on the other hand, it is possible to make a fair estimate of the expected return on the new investment. This is especially the case with completely new projects.

In passing, it may be noted that the measurement of the return on capital employed in any long-standing concern of size and variety raises a number of issues which cannot be discussed here. Suffice it to say that the approximate nature of such measurements is widely recognized.

The next problem — of securing the best possible fixed asset for the money invested — is less difficult. Naturally the technical and other expert resources available to any concern will vary with its size and there is no difficulty in devising a procedure to ensure that these resources are used to the full (see section IV below).

The financial oversight of capital expenditure is also comparatively straightforward. Procedures can be devised by the accounts and finance sections of the concern to provide for adequate progress reports on capital expenditure being undertaken. The importance of such oversight must, however, not be underestimated, especially in those concerns which have limited financial resources, including their capacity to borrow.

Lastly, whether or not a procedure will work smoothly, flexibly and speedily, is a matter of management and needs no special discussion.

These difficulties (and there are others) in devising satisfactory methods for controlling capital expenditure have been developed at some length in order to provide a background against which the procedure for control and oversight can be set. They serve, in addition, to make one essential point. Any procedure, however carefully devised, cannot by itself provide an adequate oversight and control of capital expenditure. Procedure is no substitute for good management. Unless all levels of management are at all times fully aware of the financial implications of capital expenditure — of the fact that new expenditure locks up financial resources (quite apart from the additional working capital involved), procedural control is of little or no value. On the other hand, once management is conscious of these facts a well devised procedure can do much to sharpen up the control. This is especially true in a large and diverse concern.

III. THE ORGANIZATION OF THE UNILEVER CONCERN

The brief description of the organization of the Unilever Concern which follows is extracted from an address given by the Chairman, Sir Geoffrey Heyworth, to the Institute of Public Administration in March 1949.

The Unilever organization consists of two holding companies — Unilever Limited, the English company, and Unilever N.V., the Dutch company — with identical Boards and with Memoranda and Articles of Association as similar as the legal systems of England and

Holland will allow. The Boards are regarded as too large to deal in the first instance with policy questions or to handle detailed operations. These functions of higher managements are therefore delegated to groups which operate on two levels. At the higher level there is the Special Committee, appointed by the two Boards annually and consisting of a few of their members who are freed from all routine executive duties; to them the Boards have delegated powers to deal with broad policy, to co-ordinate the work of other directors and to supervise the operation of advisory and service departments. On the lower level there are three groups outside the United Kingdom. The first two have regional responsibility, one for the business in Western Europe, and the other for those outside Western Europe and the United Kingdom. The third group is responsible for the affairs of The United Africa Company. It operates a self-contained organization responsible for the whole management of that company's mercantile and industrial activities wherever they may take place. These management groups include members of the Board but they also have other members. Alongside these groups are a series of specialist advisory and service groups whose function is to act as a repository of the latest and best knowledge and to make it available wherever it may be needed throughout the organization.

In most countries, active operational management is in the hands of a single national management responsible for all the Unilever activities. In the U.K., however, the various sides of the business are of such importance that the functions which are performed elsewhere by national managements are split among five Executives — as they are called — responsible for the five principal sections of the business: soap, margarine, oil mills, food and toilet preparations.

These national managements or Executives have under their responsibility the individual operating units which vary in size and structure according to the particular requirements of the business carried on. Since it is for the support of these units that the whole organization has been devised, and since it is upon the skill and efficiency of these units that the organization is finally dependent, it is therefore a fundamental purpose of the higher level management to place the operating units in a position to perform their essential functions with the minimum of trouble and difficulty.

IV. CONTROL AND OVERSIGHT OF CAPITAL EXPENDITURE WITHIN UNILEVER

In a concern of the size and nature of Unilever the control of capital expenditure is of major importance. The actual capital

expenditure ranges over many projects in many countries, and the advantages from having so wide a choice of projects on which new capital expenditure can be incurred are equalled only by the difficulties of selection. Capital expenditure may cover a soap and margarine works in Pakistan, a new concrete roof for a small retail store in West Africa, ice cream refrigerators for retail shops in the United Kingdom, tea bag machines in the U.S.A., a synthetic cream plant in Finland, perfumery equipment for Brazil, and research laboratories in the United States.

Against this background, the procedure in Unilever endeavours to satisfy two criteria:

(*a*) to achieve the maximum advantage from the size of the concern, with its command of large financial and technical resources, its ability to undertake long range investment and to expand in new directions and, at the same time,

(*b*) to delegate the maximum of authority and responsibility to the operating units.

To meet the first criterion it is necessary to have centralized control over as much capital expenditure as possible. Only in this way can advantage be taken of the command of large resources, i.e. their deployment to where they are most needed and can most profitably be employed. As stated above, however, there is much capital expenditure which is unavoidable, ranging from necessary replacements to the expenditure enforced by the action of competitors. The balance of resources available can, however, be influenced by independent decisions and the object of the system of control over this balance must be to avoid engaging too large a proportion at any one time.

The second criterion is met by giving operating units an annual budget of capital expenditure as the basis of their forward planning (see below). When it comes to actual expenditure, local limits of expenditure are set which enable smaller items of expenditure to be incurred without higher authority. For larger items, access is afforded to a system which will, with the minimum of delay, give authority to incur larger amounts of capital expenditure provided they can be fully justified (see page 251).

The *capital expenditure budget* is an integral part of the commercial forecast (the Annual Estimate) which each operating unit makes toward the end of each calendar year in respect of the following year. The other main items in the Annual Estimate cover prospective sales and costs, operating profits or losses, working capital requirements and changes in cash. By the end of October, each operating

unit throughout the world has to return a capital expenditure budget to London in respect of the following year. The budgets summarize the projects that the managements of the individual operating units wish to undertake during the ensuing year under three headings:

(i) expenditure still to be incurred on projects already authorized — whether actually started or not,

(ii) the estimated amount of expenditure on replacements,

(iii) the estimated amount of expenditure on expansion.

Projects which will each cost not more than a given figure are noted in total only with an indication of the probable total expenditure on such projects during the coming year. These projects fall within the so-called 'local limits' (see page 251). Projects which will cost more than the limits are set out individually with a brief description of each project, its estimated cost, and the amount likely to be spent in the budget year. These items have to be supported by a justification of the expenditure including, where possible, an estimate of any additional profits or savings in costs.

Where any one company is engaged in more than one industry the projects are listed under the appropriate industry headings.

Finally, the budget statements give the estimated depreciation (both normal depreciation and the Fixed Assets Replacement Reserve) to be set aside in the ensuing year both for existing assets and for new assets coming into use, thus drawing attention to the difference between the proposed capital expenditure and the sums which are to be put aside for depreciation out of profits. (The Fixed Assets Replacement Reserve is a debit to profits designed to ensure that the provision made for the depreciation of assets reflects current replacement values. The amount of depreciation allowed by taxation authorities is normally inadequate since it is based on certain percentages of the values of the assets at some date in the past when the value of money was different. The F.A.R.R., like all provisions in excess of these percentages, attracts no tax relief.)

The individual company managements naturally will not prepare their capital expenditure budgets *in vacuo*. They will have, in the first place, the projects which have been previously authorized and on which work may or may not have been started. Where no expenditure has been incurred they will have to decide if they still wish to proceed with the projects or whether their plans have been overtaken by events. Next, during the year information will have accumulated about required replacements; they will have had

discussions with their Executives in the United Kingdom, with their national managements, or with Contact Directors about new projects; they will have been in touch with Technical Division and other Headquarters service and advisory departments about various aspects of their longer term plans. Any major new enterprise will have been discussed at length within the Concern and will normally have already reached the Special Committee before it has to be included in the capital expenditure budget for the following year.

At this stage, the first process of selection will take place. The local management will have the experience of the treatment of its previous budgets and it may well have learned something about the 'climate of opinion' at Headquarters. The chairman of the local company will hesitate to send forward projects which are likely to receive rough treatment higher up the line.

The route followed by the budget after its approval by the Chairman of the local operating unit depends upon the location of the company. In the U.K. budgets pass to the Executive concerned, thence to Technical Division; on the Continent of Europe they will pass first to the National Management for the country, thence to the Rotterdam Group and then to Technical Division. The overseas companies send their budgets to the Contact Directors and Technical Division.

At this stage there is a further severe scrutiny of the budgets and a more intensive selection will take place. In the U.K. the Oil Mills Executive, for example, will receive budgets from a number of operating companies which, when added together, will give the capital expenditure budget for the entire Executive. That Executive may decide that the total is too large, and looking at their operations as a whole, could not be justified to the Special Committee. It will therefore 'prune' the budgets of the individual operating units both in content and as between the individual companies. Similar action will be taken in London and Rotterdam on budgets received from companies outside the U.K. and the Netherlands.

Once the budget — revised if necessary — has been approved at this level, it will pass through the Technical Division of Unilever which may have a number of comments to make about the proposals in the light of their technical knowledge. The capital expenditure budgets of all companies are then summarized and presented to the Special Committee and the Boards. The Special Committee examines the capital expenditure budgets at three stages. It considers them first of all in connection with the annual operating plans of sales, costs and profits. The budgets are thus considered against a background of the individual commercial plans of the companies

or groups concerned for the following year. It reviews the budgets again when they are presented in total as combined proposed capital expenditure of the entire Unilever Concern. At this stage the expenditure can be looked at globally in relation to such factors as the amount of depreciation being put aside. The final review takes place when the financial forecasts of the Unilever Concern are made. A final comparison is then possible between the estimated capital expenditure in cash and the financial resources available to meet it, in the light of other claims upon those resources, e.g. for working capital.

When the capital expenditure budgets of the operating companies have been approved for the ensuing year they provide the local managements with a broad basis for their activities. They do not, however, provide authority to incur any item of actual expenditure in excess of local limits. Each item in excess of the local limits requires specific authority from the Board of Limited or N.V. as the case may be (see below).

Capital Proposals. The procedure for securing authority to incur expenditure on projects in excess of local limits follows the general pattern of procedure for obtaining approval in principle for capital expenditure budgets.

The authority to incur such expenditure is vested in the Boards of Directors of Unilever Limited and Unilever N.V. In order to ensure that speedy decisions may be taken, these Boards have delegated certain authority to the Executives in the U.K. and to National Managements elsewhere and to the Technical Division. These in turn have delegated some authority to the operating units, the amount of the authority varying from company to company. Returns must be made at set intervals of the total amount of expenditure authorized in this way. All projects in excess of a given figure as well as all projects not included in the budget have to be submitted to the Special Committee and thence to the Boards of Limited or N.V. as the case may be.

The form used to seek authority to incur expenditure in excess of local limits is called a 'capital proposal' and is prepared in a standard form. It includes a comprehensive description of the project, details of expected cost, the advantages of the project, and its proposed treatment in the accounts. The amounts expected to be spent in the year are also noted. Since, with the best will in the world, estimates of cost are likely to be inaccurate in these days, the company managements attempt to keep these under constant review in the form of progress reports on the status of each project authorized. If it appears that the actual cost is going to exceed the estimate a

supplementary estimate will be prepared for submission through the same channels as the original proposal. Over-expenditure which has not been covered by a supplementary proposal is dealt with administratively.

If the project involves replacement or disposal of assets the form has to show book values, estimated receipts of sale, and the profit/loss thus arising.

The capital proposals are prepared in the operating companies. They may have been included in the budget of the current year; the need may on the other hand have arisen at short notice, e.g. an emergency or a change in processing, and this would not have appeared in the budget; it may also reflect new ideas for savings or improvements since the budget was prepared. Once the local management decides to proceed with a proposal an estimate of likely cost has to be prepared from quotations received and the necessary drawings made. Expert advice may be required at this stage on local transport, local Council, Post Office, public services and related matters. Next a narrative of the reasons for putting forward the proposal must be prepared along with full justification and such estimates as can be made of the savings in costs or the additional profits. When finally approved by the chairman of the operating company, the proposal is sent forward to the next stage in the line of authority (e.g. the Executive in the United Kingdom).

The proposals are submitted to further scrutiny at this stage although much consultation will probably have already taken place. Thereafter the form is sent to Technical Division which is the focal point for receiving capital proposals which require the approval of the Boards of Unilever as well as for capital expenditure budgets. At this stage the proposal is subject to full examination by Technical Division and by other Head Office advisory and service departments. Technical Division may already be aware of the proposal and they may have technical advice to offer. Each proposal is discussed at a weekly meeting of technical Division to ensure that the widest possible technical knowledge is brought to bear on the project. Admittedly in some cases the proposals may have a purely commercial aspect, e.g. ice cream refrigerators for retail shops or the purchase of travellers' cars. Other advisory departments may have views to put forward, e.g. on the possibility of financing the project if it is to be carried out in a foreign country. It is then passed to the Special Committee which recommends the authority to the respective Boards of Limited or N.V.

It remains to examine briefly the control over capital expenditure after authority has been granted. At the operating company level the local management usually prepares a progress report at given

intervals showing the status of each project authorized. This report will bring out delays in execution as well as the likelihood that the estimated expenditure will be exceeded. Half-yearly reports are sent to Head Office showing the amounts spent against the various proposals, as well as the disposal of assets.[1]

From all these sources of information a consolidated statement is prepared annually for the Board showing the capital expenditure, proceeds of disposals, depreciation provisions and repairs expenditure. This statement is accompanied by a report featuring the main projects on which capital expenditure has been incurred, the principal sales of assets during the year and any important variations in depreciation provisions and repairs between the current and the previous year.

UNILEVER HOUSE, LONDON

[1] It will be realized that these controls over capital expenditure after authorization are chiefly concerned with checking whether the estimates of expenditure required are fulfilled, or whether they have been exceeded, and also whether there have been undue delays in starting the authorized project. Naturally management watches the general profitability of new capital expenditure, but there are limits to the detail in which this can be done. In general, as was noted on page 244 above, it is not easy to check the outcome of a particular piece of capital expenditure unless it represents a new project standing largely on its own feet. In many cases new capital expenditure gets completely mixed in with existing assets; all that is possible here is to study the profitability of the total investment of which the new expenditure has been only part. At the same time, the past and expected profits of a particular business will be taken fully into account in deciding the amount of new capital expenditure which will be injected.

PUBLICATIONS RECEIVED

The American Economic Review, Vol. XLIII, No. 2, May 1953, Papers and Proceedings of the 65th Annual Meeting of the American Economic Association.

The Controller, U.S.A., April, May and June 1953.

The Cost Accountant, the Official Journal of the Institute of Cost and Works Accountants, London, Vol. 31, No. 12, May 1953, and Vol. 32, No. 1, June 1953.

Ekonomisk Tidskrift, Vol. LV, No. 1, March 1953, and No. 2, June 1953.

Explorations in Entrepreneurial History, Research Center in Entrepreneurial History, Harvard University, Vol. V, No. 3, March 1953.

The Journal of the Glasgow and West of Scotland Commercial College, Vol. 2, No. 2, February 1953.

The Management Review, American Management Association, April, May and June 1953.

Management under Nationalisation, studies in decentralisation, The Acton Society Trust, 1953.

The Quarterly Journal of Economics, Vol. LXVII, No. 1, February 1953, and No. 2, May 1953.